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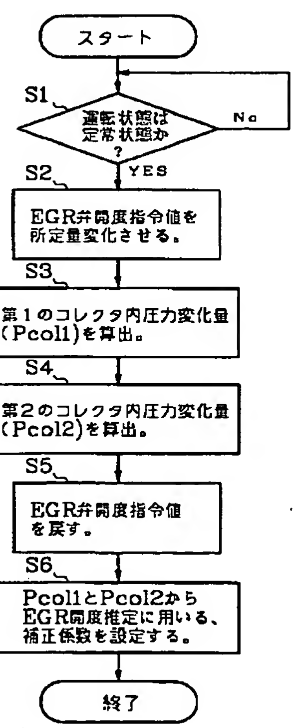
(54)【発明の名称】　内燃機関のＥＧＲ制御装置

(57)【要約】
【課題】内燃機関のＥＧＲ制御精度を向上する。。
【解決手段】機関が定常運転状態であるときにＥＧＲ弁開度指令値を所定量変化させ、ＥＧＲ弁開度以外のパラメータを用いて第１のコレクタ内圧力変化量Ｐｃｏｌ１を算出し、ＥＧＲ弁開度に応じた前記所定量変化前後のコレクタ内圧力推定値の差圧によって第２のコレクタ内圧力変化量Ｐｃｏｌ２を算出し、ＥＧＲ弁開度指令値を元に戻した後、前記Ｐｃｏｌ１とＰｃｏｌ２とに基づいてＥＧＲ弁開度の推定に用いる補正係数を設定する。



【特許請求の範囲】

【請求項１】機関の排気系と吸気系とを接続するＥＧＲ通路に介装されたＥＧＲ弁を介して排気の一部を吸気系に還流する内燃機関のＥＧＲ制御装置において、

前記ＥＧＲ弁の開度を所定量変化させたときの吸気系内圧力の変化量を、ＥＧＲ弁の開度以外のパラメータを用いて検出すると共に、ＥＧＲ弁の開度に応じた前記所定量変化前後の吸気系内圧力推定値の差圧によって検出し、これら両検出値を比較してＥＧＲ弁の詰まり量を推定し、該詰まり量に応じたＥＧＲ弁の開度制御値の補正を行うようにしたことを特徴とする内燃機関のＥＧＲ制御装置。

【請求項２】機関の排気系と吸気系とを接続するＥＧＲ通路に介装されたＥＧＲ弁を介して排気の一部を吸気系に還流する内燃機関のＥＧＲ制御装置において、

所定の運転条件で前記ＥＧＲ弁の開度を所定量変化させるＥＧＲ弁開度強制変化手段と、

前記ＥＧＲ弁開度強制変化手段によりＥＧＲ弁開度を所定量変化させたときの吸気系内圧力の変化量を、ＥＧＲ弁の開度以外のパラメータを用いて検出する第１の吸気系内圧力変化量検出手段と、

前記ＥＧＲ弁の開度に応じた吸気系内圧力を推定する吸気系内圧力推定手段と、

前記ＥＧＲ弁開度強制変化手段によりＥＧＲ弁の開度を所定量変化させたときの吸気系内圧力の変化量を、前記吸気系内圧力推定手段によって推定した前記所定量変化前後の吸気系内圧力の差圧によって検出する第２の吸気系内圧力変化量検出手段と、

前記第１の吸気系内圧力変化量検出手段によって検出した第１の吸気系内圧力変化量と、前記第２の吸気系内圧力変化量検出手段によって検出した第２の吸気系内圧力変化量と、を比較してＥＧＲ弁の詰まり量を推定し、該詰まり量に応じたＥＧＲ弁の開度制御値の補正を行うＥＧＲ弁開度制御値補正手段と、

を含んで構成したことを特徴とする内燃機関のＥＧＲ制御装置。

【請求項３】吸気系内に吸入される新気量を検出する吸気系内吸入新気量検出手段を含み、前記第１の吸気系内圧力変化量検出手段は、前記ＥＧＲ弁開度の所定量の変化の前後で前記吸気系内吸入新気量検出手段による吸気系内に吸入される新気量の検出値に基づいて該変化前後での吸気系内圧力の変化量を算出することを特徴とする請求項２に記載の内燃機関のＥＧＲ制御装置。

【請求項４】吸気系内の圧力を検出する吸気系内圧力検出手段を含み、前記第１の吸気系内圧力変化量検出手段は、前記ＥＧＲ弁開度の所定量の変化の前後での前記吸気系内圧力検出手段による吸気系内圧力の検出値に基づいて該変化前後での吸気系内圧力の変化量を算出することを特徴とする請求項２に記載の内燃機関のＥＧＲ制御装置。

【請求項５】前記吸気系内圧力推定手段は、機関回転速度と、吸気系内に吸入される新気量と、機関に供給される燃料量と、ＥＧＲ弁開度と、に基づいて吸気系内圧力を推定することを特徴とする請求項２に記載のＥＧＲ制御装置。

【請求項６】ＥＧＲ弁の開度に応じたＥＧＲ通路内の圧力を推定するＥＧＲ通路内圧力推定手段と、を含み、該ＥＧＲ通路内圧力推定手段によるＥＧＲ通路内圧力の推定値と前記吸気系内圧力推定手段による吸気系内圧力の推定値又は吸気系内圧力の検出値とに基づいて目標ＥＧＲ量に応じたＥＧＲ弁開度制御量を設定してＥＧＲ制御を行いつつ、前記ＥＧＲ弁開度の詰まり量を推定して少なくともＥＧＲ通路内圧力の推定に使用されるＥＧＲ弁開度の推定値を補正することにより、ＥＧＲ弁開度制御量を補正することを特徴とする請求項１～請求項５のいずれか１つに記載の内燃機関のＥＧＲ制御装置。

【請求項７】機関の定常運転状態を判定する定常運転状態判定手段を含み、前記ＥＧＲ弁開度強制変化手段は、前記定常運転状態判定手段により判定された機関の定常運転状態のときにＥＧＲ弁開度を所定量変化させることを特徴とする請求項１～請求項６のいずれか１つに記載の内燃機関のＥＧＲ制御装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、内燃機関のＥＧＲ（排気還流）制御装置に関し、特に、ＥＧＲ制御精度を向上させた技術に関する。

【０００２】

【従来の技術】車両用内燃機関においては、一般にＮＯｘ低減のため排気の一部を吸気系に還流するＥＧＲ制御装置が採用されている。従来の内燃機関のＥＧＲ制御装置としては、例えば特開平９－５３５１９号に示されるようなものがある。このものでは、機関回転速度と、吸気系のコレクタに吸入される新気量と、目標燃料噴射量と、現在のＥＧＲ弁開度指令値（開度制御量）と、に基づいて、コレクタ内の圧力とＥＧＲ通路内の圧力とを推定し、これら両圧力の推定値とＥＧＲ弁を通過するＥＧＲ量の要求値（目標ＥＧＲ量）とに基づいて、新たな運転条件に応じたＥＧＲ弁開度指令値を設定してＥＧＲ制御を行っている。

【０００３】

【発明が解決しようとする課題】しかしながら、このような従来のＥＧＲ制御装置では、以下のような問題がある。即ち、前記従来装置では、実際のＥＧＲ弁開度がＥＧＲ弁開度指令値に略一致することを前提にして、コレクタ内の圧力とＥＧＲ通路内の圧力の推定を行っているが、ＥＧＲ弁を通過するＥＧＲガスに含まれる煤がＥＧＲ弁を詰まらせることによって、ＥＧＲガスが通過できる実効的なＥＧＲ弁開度は減少してしまう可能性がある。この場合、コレクタ内圧力とＥＧＲ通路内圧力の推

定精度が低下し、その結果、ＥＧＲ制御精度が低下してしまう。

【０００４】なお、このことは、前記圧力推定を行う従来方式に限らず、機関の運転状態例えば機関回転速度とアクセル開度等の負荷とから直接ＥＧＲ弁開度指令値を設定するようなものでも同様であり、ＥＧＲ弁の詰まりを考慮してＥＧＲ弁開度指令値を設定しないものである限り同様である。本発明は、このような従来の実状に鑑みなされたもので、ＥＧＲ弁の詰まりを推定してＥＧＲ制御を補正することにより、ＥＧＲ制御精度を向上させた内燃機関のＥＧＲ制御装置を提供することを目的とする。

【０００５】

【課題を解決するための手段】このため、請求項１に係る発明は、機関の排気系と吸気系とを接続するＥＧＲ通路に介装されたＥＧＲ弁を介して排気の一部を吸気系に還流する内燃機関のＥＧＲ制御装置において、前記ＥＧＲ弁の開度を所定量変化させたときの吸気系内圧力の変化量を、ＥＧＲ弁の開度以外のパラメータを用いて検出すると共に、ＥＧＲ弁の開度に応じた前記所定量変化前後の吸気系内圧力推定値の差圧によって検出し、これら両検出値を比較してＥＧＲ弁の詰まり量を推定し、該詰まり量に応じたＥＧＲ弁の開度制御値の補正を行うようにしたことを特徴とする。

【０００６】請求項１に係る発明によると、ＥＧＲ弁の開度を所定量変化させると、吸気系内に供給されるＥＧＲガス量が変化する結果、吸気系内の圧力が変化する。この吸気系内圧力の変化量をＥＧＲ弁開度以外のパラメータを用いて検出した検出値は、ＥＧＲ弁の詰まりによる誤差を含むことなく正確に求められる。

【０００７】一方、ＥＧＲ弁開度から推定した前記所定量変化前後の吸気系内圧力の差圧によって吸気系内圧力の変化量を検出した検出値は、変化前後の各圧力推定値がＥＧＲ弁に詰まりがあるとＥＧＲ弁開度の減少によって誤差を生じ、これら変化前後の圧力推定値の差圧で求められる吸気系内圧力の変化量の検出値も誤差を生じる。

【０００８】したがって、これら吸気系内圧力の変化量のＥＧＲ弁の詰まりによる誤差を含まない検出値とＥＧＲ弁の詰まりによる誤差を含む検出値とを比較することにより、該ＥＧＲ弁の詰まり量を推定することができ、該詰まり量に応じたＥＧＲ弁の開度制御値の補正を行うことにより、ＥＧＲ制御精度が向上する。また、請求項２に係る発明は、図１に示すように、機関の排気系と吸気系とを接続するＥＧＲ通路に介装されたＥＧＲ弁を介して排気の一部を吸気系に還流する内燃機関のＥＧＲ制御装置において、所定の運転条件で前記ＥＧＲ弁の開度を所定量変化させるＥＧＲ弁開度強制変化手段と、前記ＥＧＲ弁開度強制変化手段によりＥＧＲ弁開度を所定量変化させたときの吸気系内圧力の変化量を、ＥＧＲ弁の開度以外のパラメータを用いて検出する第１の吸気系内圧力変化量検出手段と、前記ＥＧＲ弁の開度に応じた吸気系内圧力を推定する吸気系内圧力推定手段と、前記ＥＧＲ弁開度強制変化手段によりＥＧＲ弁の開度を所定量変化させたときの吸気系内圧力の変化量を、前記吸気系内圧力推定手段によって推定した前記所定量変化前後の吸気系内圧力の差圧によって検出する第２の吸気系内圧力変化量検出手段と、前記第１の吸気系内圧力変化量検出手段によって検出した第１の吸気系内圧力変化量と、前記第２の吸気系内圧力変化量検出手段によって検出した第２の吸気系内圧力変化量と、を比較してＥＧＲ弁の詰まり量を推定し、該詰まり量に応じたＥＧＲ弁の開度制御値の補正を行うＥＧＲ弁開度制御値補正手段と、を含んで構成したことを特徴とする。

【０００９】請求項２に係る発明によると、ＥＧＲ弁開度強制変化手段によってＥＧＲ弁開度を強制的に所定量変化させると、吸気系内に供給されるＥＧＲガス量が変化する結果、吸気系内の圧力が変化する。この吸気系内圧力の変化量を第１の吸気系内圧力検出手段によってＥＧＲ弁開度以外のパラメータを用いて検出する。この検出値は、ＥＧＲ弁の詰まりによる誤差を含むことなく正確に求められる。

【００１０】一方、第２の吸気系内圧力検出手段は、吸気系内圧力推定手段によってＥＧＲ弁の開度に応じた前記所定量変化前後の吸気系内圧力の推定値の差圧によって吸気系内圧力の変化量を検出する。この検出値は、変化前後の各圧力推定値がＥＧＲ弁に詰まりがあるとＥＧＲ弁開度の減少によって誤差を生じ、これら変化前後の圧力推定値の差圧で求められる吸気系内圧力の変化量の検出値も誤差を生じる。

【００１１】ＥＧＲ弁開度制御値補正手段は、これら吸気系内圧力の変化量のＥＧＲ弁のＥＧＲ弁の詰まりによる誤差を含まない検出値とＥＧＲ弁の詰まりによる誤差を含む検出値とを比較することにより、該ＥＧＲ弁の詰まり量を推定し、該詰まり量に応じたＥＧＲ弁の開度制御値の補正を行う。以上のようにＥＧＲ弁の詰まり量を推定してＥＧＲ弁の開度制御値を補正することにより、ＥＧＲ制御精度が向上する。

【００１２】また、請求項３に係る発明は、吸気系内に吸入される新気量を検出する吸気系内吸入新気量検出手段を含み、前記第１の吸気系内圧力変化量検出手段は、前記ＥＧＲ弁開度の所定量の変化の前後で前記吸気系内吸入新気量検出手段による吸気系内に吸入される新気量の検出値に基づいて該変化前後での吸気系内圧力の変化量を算出することを特徴とする。

【００１３】請求項３に係る発明によると、吸気系内に吸入される新気量は、ベルヌーイの式を用いて次式（１）のように表すことができる。

$$Qw = \{2 (Pcol - Pa) \times \rho a\}^{1/2} \times Atvo \cdots (1)$$

ただし、
Ｑｗ：吸気系内に吸入される新気量（ｋｇ／ｓ）
Ｐｃｏｌ：吸気系内の圧力（Ｐａ）
Ｐａ：大気圧（Ｐａ）
ρａ：大気密度（ｋｇ／m^3）
Ａｔｖｏ：吸気系内の新気入口開口面積（m^2）
ここで、ＥＧＲ弁開度を所定量変化させた場合に、前記の式で大気圧Ｐａ、大気密度ρａ、吸気系内の新気入口開口面積Ａｔｖｏについては変化しないと考えられるため、第１の吸気系内圧力変化量検出手段は、吸気系内吸入新気量検出手段によって検出される吸気系内に吸入される新気量の検出値に基づいて該変化前後での吸気系内圧力の変化量を算出する。前記の式にはＥＧＲ弁開度の要素がなく、したがって、吸気系内圧力の変化量の算出値はＥＧＲ弁の詰まりによる誤差を生じない。

【００１４】このように、圧力センサを設けることなく、吸気系内圧力の変化量を算出することができる。また、請求項４に係る発明は、吸気系内の圧力を検出する吸気系内圧力検出手段を含み、前記第１の吸気系内圧力変化量検出手段は、前記ＥＧＲ弁開度の所定量の変化の前後での前記吸気系内圧力検出手段による吸気系内圧力の検出値に基づいて該変化前後での吸気系内圧力の変化量を算出することを特徴とする。

【００１５】請求項４に係る発明によると、第１の吸気系内圧力変化量検出手段は、前記ＥＧＲ弁開度の所定量の変化の前後での前記吸気系内圧力検出手段によって直接検出された吸気系内圧力の検出値に基づいて該変化前後での吸気系内圧力の変化量を算出する。これにより、該吸気系内圧力の変化量を検出するための演算量を減少することができる。

【００１６】また、請求項５に係る発明は、前記吸気系内圧力推定手段は、機関回転速度と、吸気系内に吸入される新気量と、機関に供給される燃料量と、ＥＧＲ弁開度と、に基づいて吸気系内圧力を推定することを特徴とする。請求項５に係る発明によると、前記吸気系内圧力推定手段は、機関回転速度によって吸気系容積によって生じる動特性の時定数を算出し、該時定数と吸気系内に吸入される新気量とに基づいてシリンダに吸入される新気量を算出し、機関に供給される燃料量に基づいてＥＧＲ通路内の温度を算出し、ＥＧＲ弁開度他に基づいてシリンダに吸入されるＥＧＲ量を算出し、これら算出値に基づいて吸気系内の圧力を推定する。

【００１７】また、請求項６に係る発明は、ＥＧＲ弁の開度に応じたＥＧＲ通路内の圧力を推定するＥＧＲ通路内圧力推定手段と、を含み、該ＥＧＲ通路内圧力推定手段によるＥＧＲ通路内圧力の推定値と前記吸気系内圧力推定手段による吸気系内圧力の推定値又は吸気系内圧力の検出値とに基づいて目標ＥＧＲ量に応じたＥＧＲ弁開度制御量を設定してＥＧＲ制御を行いつつ、前記ＥＧＲ弁開度の詰まり量を推定して少なくともＥＧＲ通路内圧力の推定に使用されるＥＧＲ弁開度の推定値を補正することにより、ＥＧＲ弁開度制御量を補正することを特徴とする。

【００１８】請求項６に係る発明によると、ＥＧＲ通路内圧力推定手段は、ＥＧＲ弁開度に応じたＥＧＲ通路内の圧力を推定し、このＥＧＲ通路内圧力の推定値と吸気系内圧力推定手段による吸気系内圧力の推定値又は吸気系内圧力の検出値とに基づいて目標ＥＧＲ量に応じてＥＧＲ弁開度制御量を設定してＥＧＲ制御を行う。

【００１９】そして、前記ＥＧＲ弁の詰まり量を推定して少なくともＥＧＲ通路内圧力の推定に使用されるＥＧＲ弁開度を補正することにより、該ＥＧＲ通路内圧力の推定値をＥＧＲ弁の詰まりによる誤差を含まない値に補正することができ、該補正された圧力の推定値を用いて該ＥＧＲ弁の開度制御値を設定することにより、実際のＥＧＲ弁の開度をＥＧＲ弁の詰まりによる誤差を生じることなく目標ＥＧＲ量が得られる開度となるように補正することができる。

【００２０】なお、ＥＧＲ弁開度制御値の設定に使用する吸気系内圧力として前記吸気系内圧力推定手段によるＥＧＲ弁開度に応じた吸気系内圧力の推定値を用いる場合には、該吸気系内圧力の推定値もＥＧＲ弁の詰まりによる誤差を含まない値に補正することができる。また、請求項７に係る発明は、機関の定常運転状態を判定する定常運転状態判定手段を含み、前記ＥＧＲ弁開度強制変化手段は、前記定常運転状態判定手段により判定された機関の定常運転状態のときにＥＧＲ弁開度を所定量変化させることを特徴とする。

【００２１】請求項７に係る発明によると、定常運転状態判定手段によって判定された機関の定常運転状態のときにＥＧＲ弁開度を所定量変化させてＥＧＲ弁の詰まり量の推定及び該推定値に基づくＥＧＲ弁開度制御量の補正を行うことにより、ＥＧＲ弁開度の詰まり量の推定精度が向上し、ひいてはＥＧＲ制御精度が向上する。

【００２２】

【発明の実施の形態】以下に本発明の実施形態を図に基づいて説明する。一実施形態のハードウエアの構成を示す図２において、過給機１は、エアフィルタ２でダストを除去されて吸気通路３に吸入された空気を吸気コンプレッサ１Ａにより圧縮過給して下流側の吸気マニホールド４へ送り込む。

【００２３】一方、機関５の燃焼室に装着された燃料噴射ノズル６には、噴射ポンプ７から各気筒に分配して燃料が圧送供給され、該燃料噴射ノズル６から燃焼室に向けて燃料が噴射され、該噴射された燃料は圧縮行程末期に着火して燃焼される。また、排気マニホールド８と吸気マニホールド４とを結んでＥＧＲ弁９を介装したＥＧＲ通路１０が接続されると共に、前記吸気通路３の吸気コンプレッサ１Ａの上流側にＥＧＲ制御時に吸気を絞って排気圧と吸気圧との差圧を拡大してＥＧＲしやすくす

るためのスロットル弁31が介装され、主としてアイドル時や低負荷時に排気改善，騒音対策のために前記スロットル弁31を絞ると同時にＥＧＲ弁9の開度を制御してＥＧＲ制御を行う。具体的には、バキュームポンプ11からの負圧を電磁弁32を介してダイアフラム装置33に導いて前記絞り弁31を絞ると同時に、前記負圧をデューティ制御される電磁弁12で大気との希釈割合を制御することによって前記ＥＧＲ弁9の圧力室に導かれる圧力を制御し、もって開度を制御することによりＥＧＲ率を制御している。これらＥＧＲ率や燃料噴射制御は、コントロールユニット13により行われる。

【0024】燃焼後の排気は、排気マニホールド8より前記過給機1の排気タービン1Ｂを回転駆動させた後、排気中に含まれるパーティキュレート（排気微粒子）等がフィルタ14で捕集され、マフラー15で消音された後に大気中に放出される。前記過給機1の吸気コンプレッサ1Ａ上流の吸気通路3には、吸入空気流量を検出するエアフローメータ16が設けられ、また、機関回転速度Ｎｅを検出する回転速度センサ17、前記燃料噴射ポンプ7のコントロールレバー開度を検出するレバー開度センサ18、水温を検出する水温センサ19等が設けられ、これらの検出値に基づいてＥＧＲ弁9の開度制御値を設定し、該開度となるようにＥＧＲ弁9を駆動してＥＧＲ制御を行う。

【0025】図3は、本実施の形態におけるＥＧＲ制御の制御ブロック図を示す。各ブロックの機能を説明すると、機関回転速度検出部51では、前記回転速度センサ＊17からの信号に基づいて機関回転速度Ｎを検出する。コレクタ吸入新気量検出部52は、吸気系内吸入新気量検出手段としての前記エアフロメータ16からの信号に基づいて吸気通路3のコレクタに吸入される新気量を検出する。

【0026】目標燃料噴射量設定部53では、機関運転状態に基づいて目標燃料噴射量を設定する。具体的には、前記検出された機関回転速度Ｎと前記レバー開度センサ18によって検出されたコントロールレバー開度ＣＬとから基本燃料噴射量Ｍｑｄｒｖをマップテーブルからの検索等により求め、これを水温等の各種補正係数によって補正して目標燃料噴射量を設定する。

【0027】コレクタ内圧力・ＥＧＲ通路内圧力推定部54は、図4に示すように、動特性推定部54ａ、シリンダ吸入新気量算出部54ｂ、シリンダ吸入ＥＧＲ量算出部54ｃ、コレクタ内圧力算出部54ｄ、コレクタ吸入ＥＧＲ量算出部54ｅ、ＥＧＲ通路内温度算出部54ｆ、コレクタ内温度算出部54ｇ、ＥＧＲ通路内圧力算出部54ｈによって構成される。なお、このコレクタ内圧力・ＥＧＲ通路内圧力推定部54の機能が、吸気系内圧力推定手段とＥＧＲ通路内圧力推定手段とを構成する。

【0028】動特性推定部54ａは、機関回転速度検出部51によって検出された機関回転速度を用いて、次式（2）に示す演算を行い、コレクタによって生じる動特性の時定数τａを算出する。

$$\tau a = (30 \times Vcol) / (N \times Vcyl \times \eta v) \quad \cdots (2)$$

ただし、
τａ：コレクタによって生じる動特性の時定数（ｓ）
Ｎ：機関回転速度（ｒｐｍ）
Ｖｃｏｌ：コレクタ容積（m^3）
Ｖｃｙｌ：行程容積（m^3）
ηｖ：体積効率
ここで、Ｖｃｏｌ、Ｖｃｙｌは定数として与える。ηｖはセンシングしてもよいし、標準的な値を与えてもよい。※

※【0029】シリンダ吸入新気量算出部54ｂでは、前記コレクタ吸入新気量検出部52で検出されるコレクタに吸入される新気量と、動特性推定部54ａで推定した前記動特性の時定数τａとを用いて次式（3）のような演算を行い、シリンダに吸入される新気量を求める。（3）式は一次遅れの関係を離散時間系の式を用いて表したものである。

【0030】

$$Qcw = \exp(-\Delta t/\tau a) \times (Z^{-1}Qcw) + \{1 - \exp(-\Delta t/\tau a)\} \times (Z^{-1}Qcw) \quad \cdots (3)$$

ただし、
Ｑｃｗ：シリンダに吸入される新気量（ｋｇ／ｓ）
Ｑｗ：コレクタに吸入される新気量（ｋｇ／ｓ）
Δｔ：サンプリング周期（ｓ）
ここで、Δｔは定数として与える。

【0031】シリンダ吸入ＥＧＲ量算出部54ｃでは、コレクタ吸入ＥＧＲ量算出部54ｅで後述するようにし★て算出されるコレクタに吸入されるＥＧＲ量と、前記動特性推定部54ａで推定した動特性の時定数τａとを用いて次式（4）のような演算を行い、シリンダに吸入されるＥＧＲ量を求める。（）式は一次遅れの関係を離散時間系の式を用いて表したものである。

【0032】

$$Qce = \exp(-\Delta t/\tau a) \times (Z^{-1}Qce) + \{1 - \exp(-\Delta t/\tau a)\} \times (Z^{-1}Qce) \quad \cdots (4)$$

ただし、
Ｑｃｅ：シリンダに吸入されるＥＧＲ量（ｋｇ／ｓ）
Ｑｅ：コレクタに吸入されるＥＧＲ量（ｋｇ／ｓ）
Δｔ：サンプリング周期（ｓ）

ここで、Δtは定数として与える。

【0033】コレクタ内圧力算出部54dは、前記検出された機関回転速度Nと、コレクタ内温度算出部54gにより後述するようにして算出されるコレクタ内の温度＊＊と、前記算出されたシリンダ吸入新気量と、シリンダ吸入EGR量とを用いて、次式（5）のような演算を行い、コレクタ内の圧力Pcolを求める。

$$Pcol = Po \times (Qcw + Qce) \times (30/N) \times (Tcol/To) \times \{1/(\eta v \times \rho col \times Vcyl)\} \quad \cdots (5)$$

ただし、

Pcol：コレクタ内の圧力（Pa）

ρcol：標準状態でのコレクタ内の密度（kg／m^3）

Tcol：コレクタ内の温度（K）

To：標準状態を示す絶対温度（K）

Po：標準状態を示す絶対圧力（Pa）

ここで、Vcyl、Po、Toは定数として与える。ρcolはセンシングしてもよいし、標準的な値を与えてもよい。

【0034】コレクタ吸入EGR量算出部54eでは、後述するEGR弁開度推定部59により推定されるEG※※R弁9の開度と前記算出したコレクタ内の圧力Pcolと、EGR通路圧力算出部54hで後述するように算出されるEGR通路10内の圧力から、コレクタに吸入されるEGR量を算出する。最初に、推定されたEGR弁9の開度からEGR弁9の開口面積を求める。具体的には、EGR弁9の開度とEGR弁9の開口面積の関係を、予めマップとして用意しておき、該マップからの検索等により求めればよい。該EGR弁開口面積マップ例を図7に示す。

【0035】次に、次式（6）のような演算を行い、コレクタに吸入されるEGR量を算出する。

$$Qe = \{2(Pexh - Pcol) \times \rho exh\}^{1/2} \times Segr \quad \cdots (6)$$

ただし、

Qe：コレクタに吸入されるEGR量（kg／s）

Pexh：排気管内の圧力（Pa）

Pcol：コレクタ内の圧力（Pa）

ρexh：標準状態での排気密度（kg／m^3）

Segr：EGR弁開口面積（m^2）

ρexhはセンシングしてもよいし、標準的な値を与えてもよい。

【0036】EGR通路内温度算出部54fは、前記目標燃料噴射量設定部53により設定された目標燃料噴射量に基づいてEGR通路10内の温度を求める。具体的には、目標燃料噴射量とEGR通路内温度との関係を予めマップとして用意しておき、該マップからの検索等により求めればよい。該EGR通路内温度推定マップの例を図8に示す。

【0037】コレクタ内温度算出部54gは、前記EGR通路内温度算出部54fによって算出したEGR通路10内の温度と、前記シリンダ吸入空気量算出部54bによって算出したシリンダ吸入空気量と、前記シリンダ吸入EGR量算出部54cによって算出したシリンダ吸入EGR量と、に基づいてコレクタ内の温度を求める。★★【0038】最初に、次式（7）に示すような演算を行い、EGR率を求める。

$$Regr = (Qce/Qcw) \times 100 \quad \cdots (7)$$

ただし、

Regr：EGR率（%）

Qcw：シリンダに吸入される新気量（kg／s）

Qce：シリンダに吸入されるEGR量（kg／s）

次に、前記のようにして求めたEGR率とEGR通路内温度とに基づいてコレクタ内の温度を求める。具体的には、EGR率とEGR通路内温度とコレクタ内温度との関係を予めマップとして用意しておき、該マップからの検索等により求めればよい。該コレクタ内温度推定マップの例を図9に示す。

【0039】EGR通路内圧力算出部54hは、前記コレクタ吸入EGR量算出部54eで算出したコレクタに吸入されるEGR量と、前記シリンダ吸入新気量算出部54bで算出したシリンダ吸入新気量と、前記EGR通路内温度算出部54fと、機関回転速度検出部54aで検出した機関回転速度Nと、に基づいてEGR通路10内の圧力を求める。

【0040】最初に、次式（8）のような演算を行う。

$$Kegr = (Qcw - Qec) \times Tegr \times (N/30) \quad \cdots (8)$$

ただし、

Qcw：シリンダに吸入される新気量（kg／s）

Qe：コレクタに吸入されるEGR量（kg／s）

Tegr：EGR通路内の温度（K）

Ne　：機関回転速度（rpm）

Kegrは中間的な変数である。

【0041】次に、KegrからEGR通路10内の圧力を求める。KegrとEGR通路内の圧力との関係は予めマップとして用意しておき、該マップからの検索等により求めればよい。該EGR通路内圧力推定マップの例を図10に示す。図3に戻って、要求EGR弁通過流量設定部55では、運転状態の変化に合わせて適切なEGR率となるように、EGR弁9を通過させたいEGR量（目標EGR量）を設定する。

【0042】EGR弁開度指令値設定部56は、要求EGR弁通過流量設定手段で設定した目標EGR量と、前記コレクタ内圧力算出部54dで算出したコレクタ内の圧力と、EGR通路内圧力算出部54hで算出したEG

Ｒ通路１０内の圧力とに基づいてＥＧＲ弁９の開度指令値を設定する。最初に、次式（９）のような演算を行な＊い、ＥＧＲ弁開口面積の要求値を求める。

【００４３】

$$YSegr=Qe\times\left[\{2(Pexh-Pcoh)\times\rho exh\}^{1/2}\right]^{-1} \quad \cdots(9)$$

ただし、

Ｑｅ：コレクタに吸入されるＥＧＲ量（ｋｇ／ｓ）

Ｐｅｘｈ：排気通路内の圧力（Ｐａ）

Ｐｃｏｌ：コレクタ内の圧力（Ｐａ）

ρｅｘｈ：標準状態での排気密度（ｋｇ／m^3）

ＹＳｅｇｒ：ＥＧＲ弁開口面積要求値（m^2）

ρｅｘｈはセンシングしても良いし標準的な値を与えてもよい。

【００４４】次に、ＹＳｅｇｒからＥＧＲ弁開度指令値を求める。具体的には、ＹＳｅｇｒとＥＧＲ弁開度指令値との関係を予めマップとして用意しておき、該マップからの検索等により求めればよい。該ＥＧＲ弁開度指令値設定マップの例を図１１に示す。ＥＧＲ弁操作部５７は、ＥＧＲ弁開度指令値変更部５８により後述するように求められる第２のＥＧＲ弁開度指令値に、実際のＥＧＲ弁開度が近づくようにＥＧＲ弁を操作する。

【００４５】ＥＧＲ弁９は、ＥＧＲ弁操作部５７の出力に従って、ＥＧＲ通路１０を開閉する。ＥＧＲ弁開度推定部５９は、後述する補正係数設定部６３で設定された補正係数と、前記ＥＧＲ弁開度指令値変更部５８で変更した第２のＥＧＲ弁開度指令値とに基づいて次式（１０）のような演算を行いＥＧＲ弁開度を求める。

【００４６】

$$Aegr=MAegr2\times Kegr \quad \cdots(10)$$

ただし、

Ａｅｇｒ：ＥＧＲ弁開度（％）

ＭＡｅｇｒ：第２のＥＧＲ弁開度指令値（％）

Ｋｅｇｒ：補正係数

診断実行部６０は、図５に示すように運転状態判定部６０ａ、診断実行判断部６０ｂによって構成される。以下各要素について説明を行う。

【００４７】運転状態判定部６０ａは、目標燃料噴射量設定部５３で設定した目標燃料噴射量と、機関回転速度検出部５１で検出した機関回転速度Ｎとに基づいて例えば以下のことを行う。目標燃料噴射量と機関回転速度とをパラメータとして複数の領域に区分した図１０のようなマップを設定し、上記２つのパラメータの入力を座標とする点が、特定の領域に所定の期間以上収まっている場合は、定常状態を表す信号を出力する。

【００４８】診断実行判断部６０ｂは、少なくとも運転状態判定部が定常状態を表す信号を出力しているときに、ＥＧＲ弁９の詰まりの診断を実行する判断を行う。尚、ＥＧＲ弁９の詰まりが、短い期間で進行しないことを前提にして、前回の診断から一定期間が経過しないと診断しないようにする等の条件を追加してもよい。

【００４９】ＥＧＲ弁開度指令値変更部５８は、診断実行判断部６０ｂによる診断実行判断結果と、ＥＧＲ弁開度指令値設定部５６により設定したＥＧＲ弁開度指令値とに基づいて第２のＥＧＲ弁開度指令値を求める。この第２のＥＧＲ弁開度指令値は、例えば図１３に示すように診断実行判断部６０ｂが診断の実行を判断してから、ｔ１秒経過後にＥＧＲ弁開度指令値を所定量減少させるが、さらにｔ２秒経過後には、再びＥＧＲ弁開度指令値に一致させる（所走量増加させてもよいが、本実施の形態では減少させる場合を想定する。）。

【００５０】また、前記診断を行っていないときは、第２のＥＧＲ弁開度指令値はＥＧＲ弁開度指令値設定部により設定したＥＧＲ弁開度指令値に一致させる。第１のコレクタ内圧力変化量算出部６１は、図６に示すように所定量変化前後コレクタ吸入新気量算出部６１ａと、第１のコレクタ内圧力変化量算出部６１ｂとによって構成される。該第１のコレクタ内圧力変化量算出部６１が第１の吸気系内圧力変化量検出手段を構成する。以下各要素について説明を行う。

【００５１】所定量変化前後コレクタ吸入新気量算出部６１ａは、診断実行判断部６０ｂによる診断実行の判断結果と、コレクタ吸入新気量検出部５２によって検出されたコレクタに吸入される新気量とに基づいて第２のＥＧＲ弁開度指令値を所定量減少させる前と後のコレクタに吸入される新気量を求める（以下、所定量減少させる前のコレクタに吸入される新気量をＱｗ１とし、所走量減少させた後のコレクタに吸入される新気量をＱｗ２とする。）。

【００５２】Ｑｗ１とＱｗ２は、具体的には図１４に示すような定常的な流量となっている時点でのコレクタに吸入される新気量である｛図１４に示すようにコレクタに吸入される新気量は、第２のＥＧＲ弁開度指令値を所定量減少させることによって、増加する（Ｑｗ２＞Ｑｗ１となる）はずである。｝。第１のコレクタ内圧力変化量算出部６１ｂは、所定量変化前後コレクタ吸入新気量算出部６１ａにより算出した、第２のＥＧＲ弁開度指令値を所走量減少させる前のコレクタに吸入される新気量（Ｑｗ１）と所定量減少させた後のコレクタに吸入される新気量（Ｑｗ２）とに基づいて、コレクタ内の圧力の変化量（第１のコレクタ内圧力変化量とする）を求める。

【００５３】まず、予め実験等により、図１５に示すようなコレクタに吸入される新気量とコレクタの新気入り口の上流側（大気側に相当）と下流側（コレクタ側に相当）の差圧の関係を示すマップを用意する。図１３のマップは（１）式によって求めることも可能である。図１３のマップを用いて、Ｑｗ１から後述する第１の差圧Ｓ

Ｐｔｖｏ１を求め、Ｑｗ２から後述する第２の差圧ＳＰｔｖｏ２を求める。第１のコレクタ内圧力変化量は、次＊式（１１）のような演算を行い求める。

【００５４】

$$\Delta Pcol1 = SPtvo2 - SPtvo1 \cdots (11)$$

ただし、

ＳＰｔｖｏ１：第２のＥＧＲ弁開度指令値を所定量減少させる前のコレクタ新気入り口での差圧（Ｐａ）

ＳＰｔｖｏ２：第２のＥＧＲ弁開度指令値を所走量減少させた後のコレクタ新気入り口での差圧（Ｐａ）

ΔＰｃｏｌ１：第１のコレクタ内圧力変化量（Ｐａ）

第２のコレクタ内圧力変化量算出部６２は、前記診断実行判断部６０による診断実行の判断結果と、コレクタ内圧力算出部により算出したコレクタ内の圧力とに基づいて第２のコレクタ内圧力変化量を求める。具体的には、第２のコレクタ内圧力変化量は、図１６に示すように、診断が開始されて、第２のＥＧＲ弁開度指令値が所定量減少する前後のコレクタ内圧力・ＥＧＲ通路内圧力推定※部５４により推定したコレクタ内圧力推定値の変化量である。該第２のコレクタ内圧力変化量算出部６２が第２の吸気系内圧力変化量検出手段を構成する。

【００５５】補正係数設定部６３は、診断実行判断部６０ｂによる診断実行の判断結果と、第１のコレクタ内圧力変化量算出部６１により算出した第１のコレクタ内圧力変化量と、第２のコレクタ内圧力変化量算出部６２により算出した第２のコレクタ内圧力変化量とに基づいて補正係数を設定する。該補正係数設定部６３がＥＧＲ弁開度制御値補正手段を構成する。

【００５６】まず、次式（１２）式のような演算を行う。

$$RPcol = (\Delta Pcol2 / \Delta Pcol1) \times 100 \cdots (12)$$

ただし、

ΔＰｃｏｌ１：第１のコレクタ内圧力変化量（Ｐａ）

ΔＰｃｏｌ２：第２のコレクタ内圧力変化量（Ｐａ）

ＲＰｃｏｌは中間的な変数である。

【００５７】次に、ＲＰｃｏｌから補正係数を求める。具体的にはＲＰｃｏｌと補正係数の関係を予めマップとして用意しておき、該マップからの検索等によって求めればよい。補正係数設定マップ例を図１７に示す。尚、診断実行判断部６０による診断実行を行うとの判断結果の出力が所定期間以上継続しなかった場合、ＥＧＲ弁９の詰まり診断中に運転状態が過渡状態に移行したと判断し、そのときに求められた補正係数は無効とする。前記診断実行を行うとの判断結果の出力が所定期間以上継続した場合は、有効とし補正係数を変更する。

【００５８】図１８は、前記ＥＧＲ弁９の詰まりの診断及び補正係数の設定のルーチンを示すフローチャートである。次に、第２の実施の形態を説明する。第２の実施の形態では、図１９に示すように、第１のコレクタ内圧力変化量の算出をコレクタに設けた吸気系内圧力検出手段としての圧力センサの信号に基づいてコレクタ内の圧力を検出するコレクタ内圧力検出部７１を有し、第１のコレクタ内圧力変化量算出部６１’が前記コレクタ内圧力検出部７１によって検出されたＥＧＲ弁開度を所定量変化させる前後でのコレクタ内圧力の変化量（図２０参照）を直接算出する点が異なり、その他の構成は、第１の実施の形態と同一である。

【００５９】第２の実施の形態では、コレクタ内圧力検出部を有することにより第１の実施の形態に比較して演算量を少なくすることができる。

【図面の簡単な説明】

【図１】本発明の構成・機能を示すブロック図。

【図２】本発明の第１の実施の形態のシステム構成を示す図。

【図３】同上実施の形態の制御ブロック図。

【図４】同じくコレクタ内圧力・ＥＧＲ通路内圧力推定部の構成を示すブロック図。

【図５】同じく診断実行部の構成を示すブロック図。

【図６】同じく第１のコレクタ内圧力変化量算出部の構成を示す図。

【図７】同じくＥＧＲ弁開口面積マップ例を示す図。

【図８】同じくＥＧＲ通路内温度推定マップ例を示す図。

【図９】同じくコレクタ内温度推定マップ例を示す図。

【図10】同じくＥＧＲ通路内圧力推定マップ例を示す図。

【図11】同じくＥＧＲ弁開度指令値設定マップ例を示す図。

【図12】同じく運転状態判定部の作用を説明するための図。

【図13】同じくＥＧＲ弁開度指令値変更部の作用を説明するための図。

【図14】同じく所定量変化前後コレクタ吸入新気量算出部の作用を説明するための図。

【図15】同じくコレクタ新気入口での差圧推定マップ例を示す図。

【図16】同じく第２のコレクタ内圧力変化量算出部の作用を説明するための図。

【図17】同じく補正係数設定マップ例を示す図。

【図18】同じくＥＧＲ弁の詰まりの診断及び補正係数設定のルーチンを示すフローチャート。

【図19】本発明の第２の実施の形態の制御ブロック図。

【図20】　第２の実施の形態におけるコレクタ内圧力変化量算出部の作用を説明するための図。

【符号の説明】

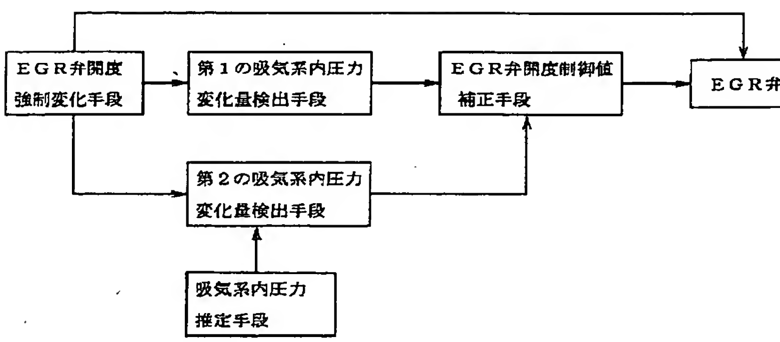
５　ディーゼル機関

７　燃料噴射量ポンプ

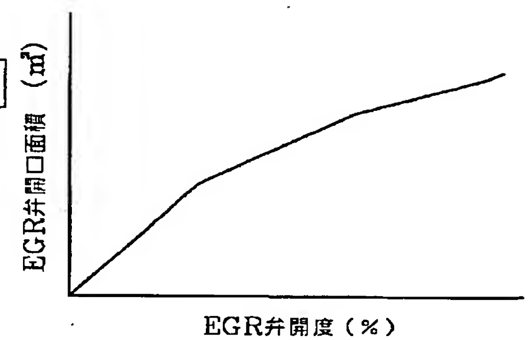
15　　16

９	ＥＧＲ弁
１０	ＥＧＲ通路
１３	コントロールユニット
１６	エアフローメータ
１７	回転速度センサ
１８	レバー開度センサ
１９	水温センサ

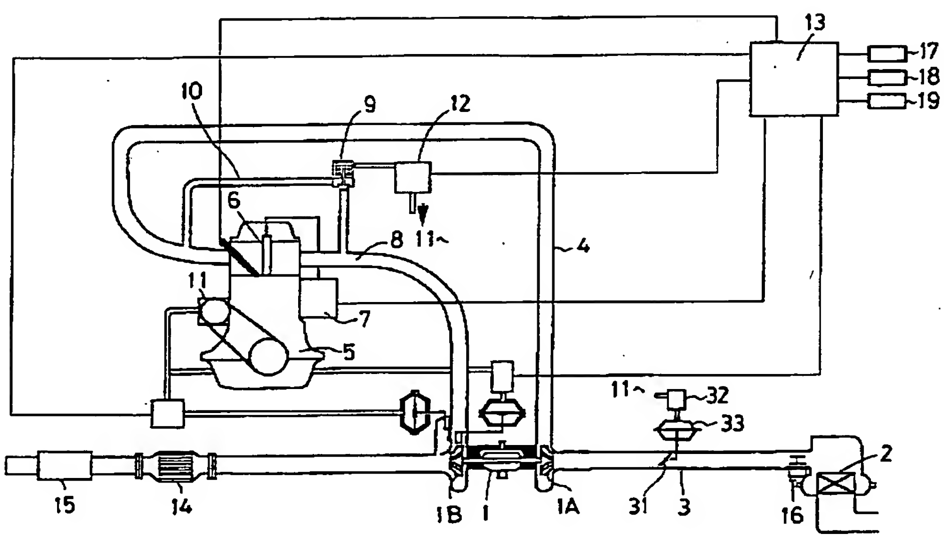
【図１】



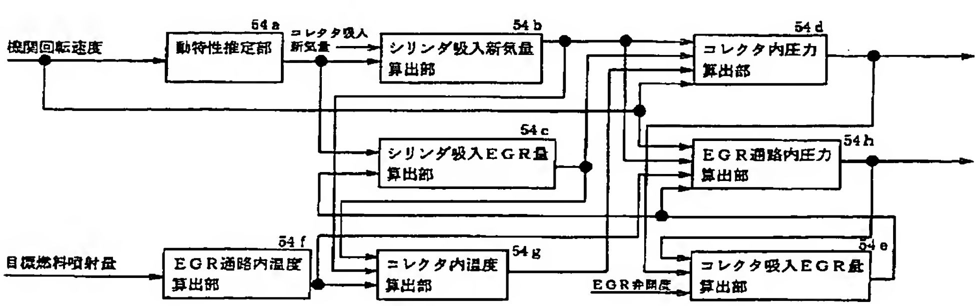
【図７】



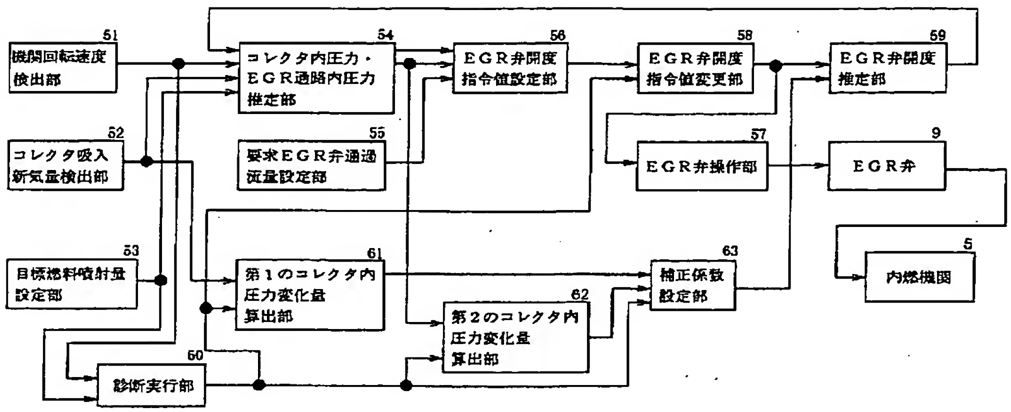
【図２】



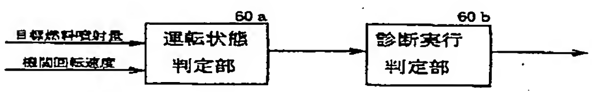
【図４】



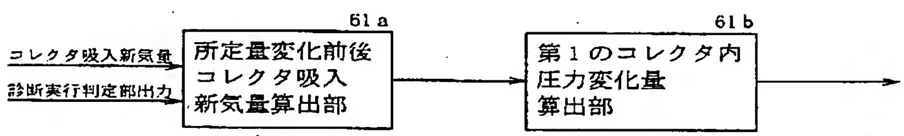
【図3】


51
機関回転速度
検出部
52
コレクタ吸入
新気量検出部
53
目標燃料噴射量
設定部
54
コレクタ内圧力・
EGR通路内圧力
推定部
55
要求EGR弁通過
流量設定部
56
EGR弁開度
指令値設定部
58
EGR弁開度
指令値変更部
59
EGR弁開度
推定部
57
EGR弁操作部
9
EGR弁
5
内燃機関
60
診断実行部
61
第1のコレクタ内
圧力変化量
算出部
62
第2のコレクタ内
圧力変化量
算出部
63
補正係数
設定部

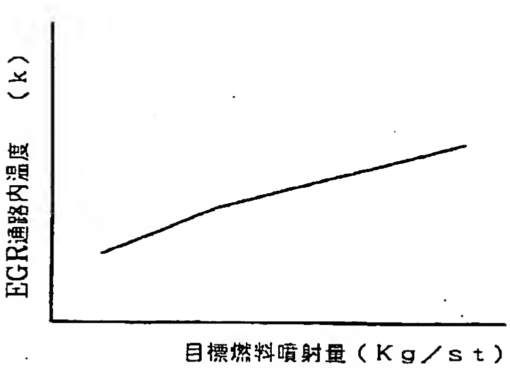
【図5】


目標燃料噴射量
機関回転速度
60a
運転状態
判定部
60b
診断実行
判定部

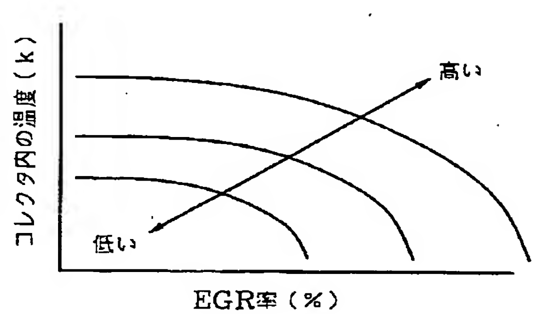
【図6】


コレクタ吸入新気量
診断実行判定部出力
61a
所定量変化前後
コレクタ吸入
新気量算出部
61b
第1のコレクタ内
圧力変化量
算出部

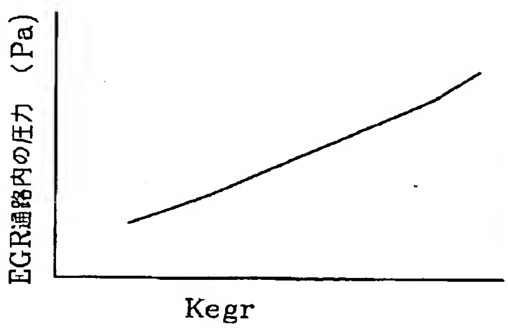
【図8】


EGR通路内温度 (k)
目標燃料噴射量（Kg／st）

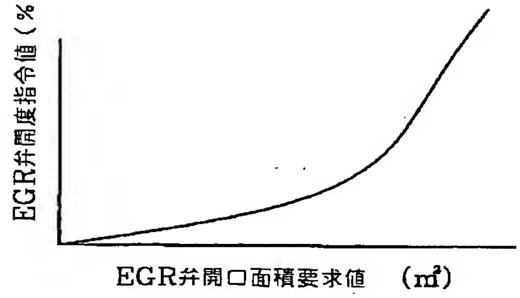
【図9】


コレクタ内の温度（k）
高い
低い
EGR率（%）

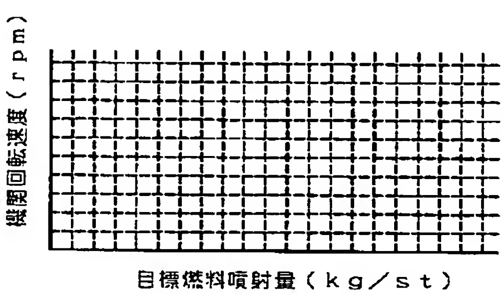
【図１０】



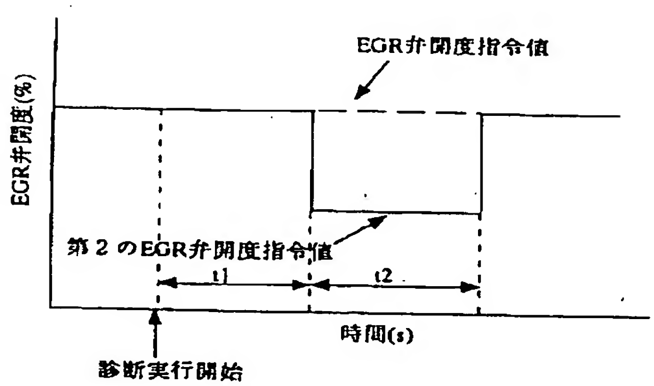
【図１１】



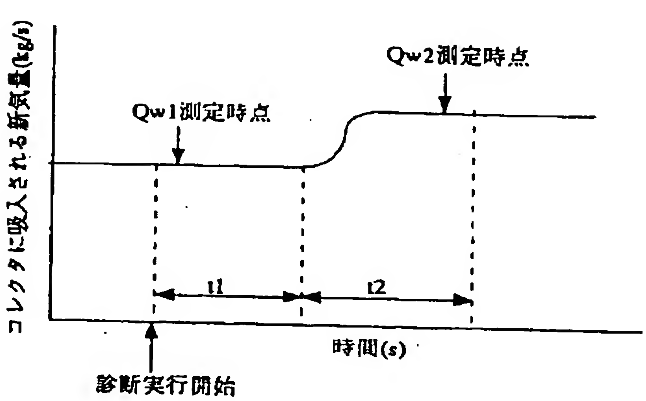
【図１２】



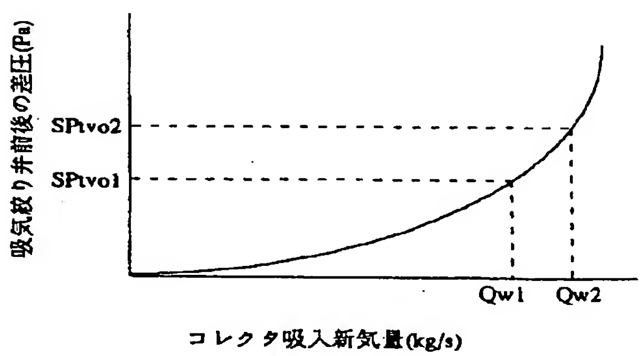
【図１３】



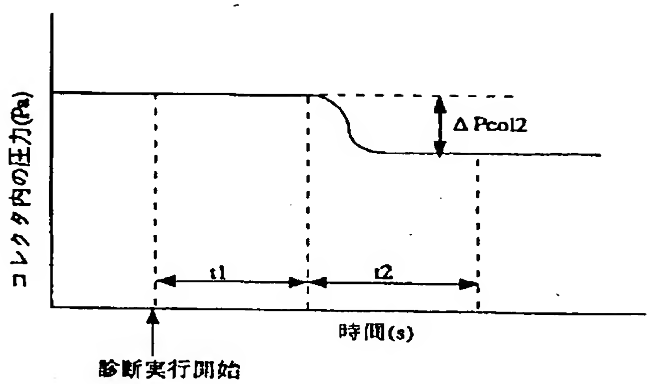
【図１４】



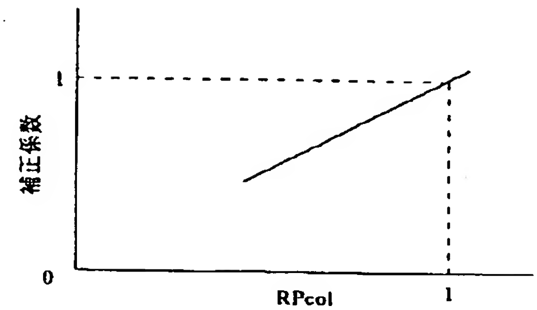
【図１５】



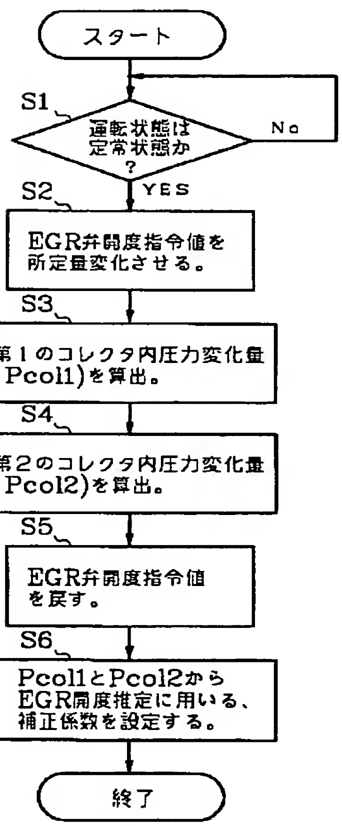
【図１６】



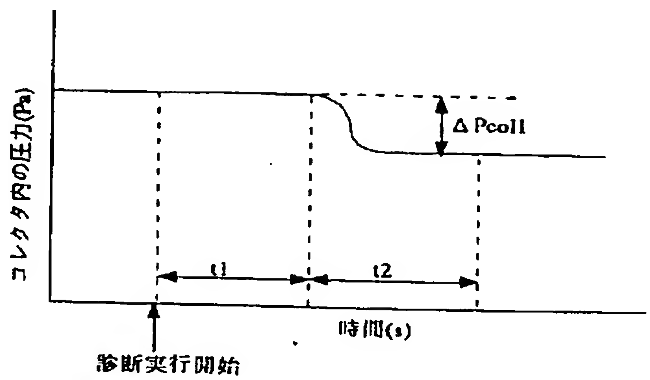
【図１７】



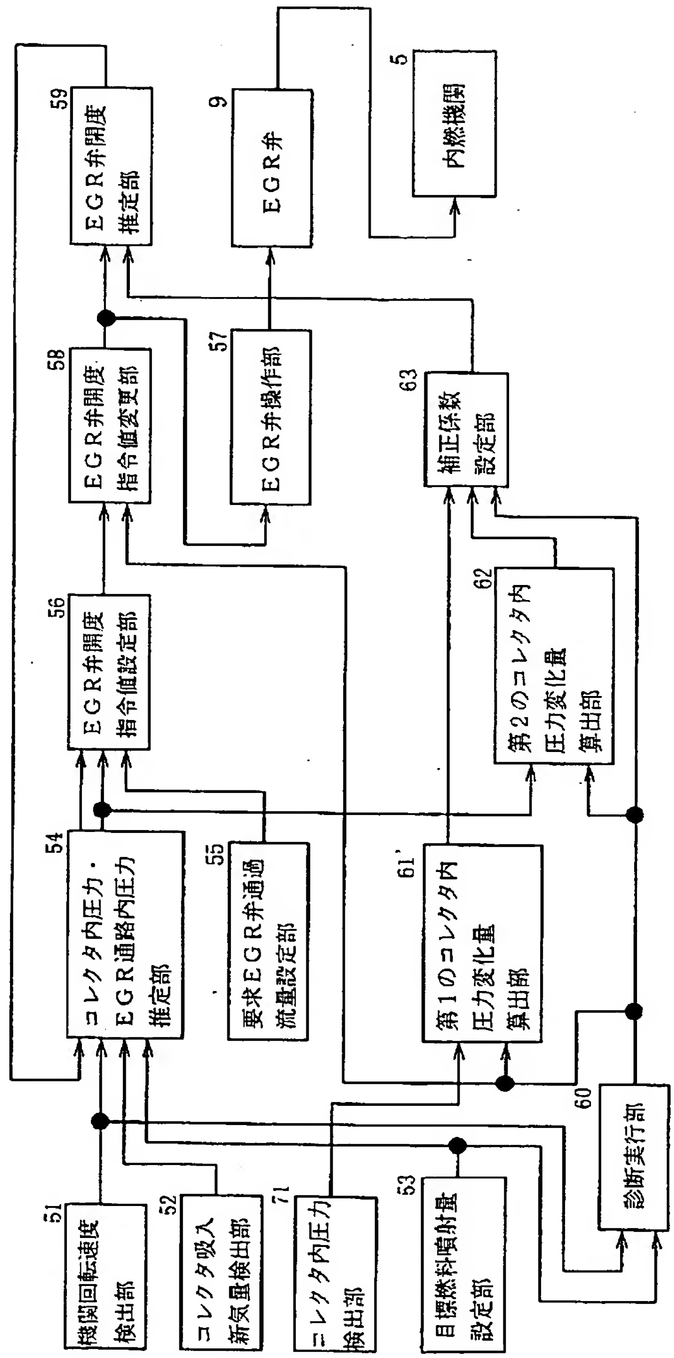
【図１８】



【図２０】



【図１９】


51
機関回転速度検出部
52
コレクタ吸入新気量検出部
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コレクタ内圧力検出部
53
目標燃料噴射量設定部
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コレクタ内圧力・ＥＧＲ通路内圧力推定部
55
要求ＥＧＲ弁通過流量設定部
61'
第１のコレクタ内圧力変化量算出部
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診断実行部
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ＥＧＲ弁開度指令値設定部
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第２のコレクタ内圧力変化量算出部
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ＥＧＲ弁開度指令値変更部
57
ＥＧＲ弁操作部
63
補正係数設定部
59
ＥＧＲ弁開度推定部
9
ＥＧＲ弁
5
内燃機関

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(71)Applicant : NISSAN MOTOR CO LTD

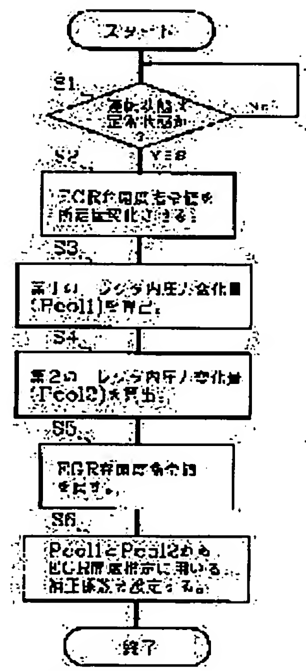
(72)Inventor : NAGAMURA KENSUKE
KAWABE TAKETOSHI

(54) EGR CONTROLLER FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:

PROBLEM TO BE SOLVED: To improve the EGR control accuracy of an internal combustion engine.

SOLUTION: An ECR valve opening degree command value is changed by a predetermined amount when an engine is in a normal operation condition, and a first collector pressure change amount Pcol1 is calculated using parameters other than EGR valve opening degree (S3). A second collector pressure change amount Pcol2 is calculated due to a difference in pressure of collector pressure estimated values before and after it is changed by the predetermined amount in accordance with the EGR valve opening degree (S4). A compensation coefficient used in the estimate of EGR valve opening degree based on Pcol1 and Pcol2 is set after the EGR valve opening degree command value is returned to its original value (S6).



LEGAL STATUS

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[Patent number]

[Date of registration]

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[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] In the EGR control unit of the internal combustion engine which flows back in an inhalation-of-air system in a part of exhaust air through the EGR valve infixed in the EGR path which connects an engine's exhaust air system and inhalation-of-air system While detecting the variation of the inhalation-of-air system internal pressure when carrying out specified quantity change of the opening of said EGR valve using parameters other than the opening of an EGR valve The EGR control unit of the internal combustion engine characterized by for the differential pressure of the inhalation-of-air system internal pressure estimate before and behind said specified quantity change according to the opening of an EGR valve detecting, and comparing both [these] the detection value, presuming the amount of plugging of an EGR valve, and amending the opening control value of the EGR valve according to this amount of plugging.
[Claim 2] In the EGR control unit of the internal combustion engine which flows back in an inhalation-of-air system in a part of exhaust air through the EGR valve infixed in the EGR path which connects an engine's exhaust air system and inhalation-of-air system Whenever [EGR valve-opening / which carries out specified quantity change of the opening of said EGR valve by the predetermined service condition] A compulsive change means, The 1st inhalation-of-air system internal pressure variation detection means which detects the variation of the inhalation-of-air system internal pressure when carrying out specified quantity change of whenever [EGR valve-opening] with a compulsive change means whenever [said EGR valve-opening] using parameters other than the opening of an EGR valve, An inhalation-of-air system internal pressure presumption means to presume the inhalation-of-air system internal pressure according to the opening of said EGR valve, The variation of the inhalation-of-air system internal pressure when carrying out specified quantity change of the opening of an EGR valve with a compulsive change means whenever [said EGR valve-opening] The 2nd inhalation-of-air system internal pressure variation detection means detected by the differential pressure of the inhalation-of-air system internal pressure before and behind said specified quantity change presumed with said inhalation-of-air system internal pressure presumption means, The 1st inhalation-of-air system internal pressure variation detected with said 1st inhalation-of-air system internal pressure variation detection means, The 2nd inhalation-of-air system internal pressure variation detected with said 2nd inhalation-of-air system internal pressure variation detection means, The EGR control unit of the internal combustion engine characterized by constituting including a control value amendment means whenever [EGR valve-opening / which compares, presumes the amount of plugging of an EGR valve, and amends the opening control value of the EGR valve according to this amount of plugging].
[Claim 3] An inhalation new-air-volume detection means in an inhalation-of-air system to detect the new air volume inhaled in an inhalation-of-air system is included. Said 1st inhalation-of-air system internal pressure variation detection means The EGR control unit of the internal combustion engine according to claim 2 characterized by computing the variation of the inhalation-of-air system internal pressure in this change order based on the detection value of the new air volume inhaled in the inhalation-of-air system by said inhalation new-air-volume detection means in an inhalation-of-air system before and after change of the specified quantity of whenever [said EGR valve-opening].
[Claim 4] Said 1st inhalation-of-air system internal pressure variation detection means is the EGR control unit of the internal combustion engine according to claim 2 characterized by computing the variation of the inhalation-of-air system internal pressure in this change order based on the detection value of the inhalation-of-air system internal pressure by said inhalation-of-air system internal pressure detection means in the change order of the specified quantity of whenever [said EGR valve-opening] including an inhalation-of-air system internal pressure detection means to detect the pressure in an inhalation-of-air system.

[Claim 5] Said inhalation-of-air system internal pressure presumption means is an EGR control unit according to claim 2 characterized by presuming inhalation-of-air system internal pressure based on engine rotational speed, the new air volume inhaled in an inhalation-of-air system, the fuel quantity supplied to an engine, and whenever [EGR valve-opening].
[Claim 6] An EGR path internal pressure presumption means to presume the pressure in the EGR path according to the opening of an EGR valve, Setting up a controlled variable based on the estimate of the EGR path internal pressure by an implication and this EGR path internal pressure presumption means, the estimate of the inhalation-of-air system internal pressure by said inhalation-of-air system internal pressure presumption means, or the detection value of inhalation-of-air system internal pressure whenever [according to the amount of target EGR(s) / EGR valve-opening], and performing EGR control The EGR control unit of the internal combustion engine of any one publication of claim 1 characterized by amending a controlled variable whenever [EGR valve-opening] by amending the estimate of whenever [EGR valve-opening / which presumes the amount of plugging of whenever / said EGR valve-opening /, and is used for presumption of EGR path internal pressure at least] - claim 5.
[Claim 7] A compulsive change means is the EGR control unit of the internal combustion engine of any one publication of claim 1 characterized by carrying out specified quantity change of whenever [EGR valve-opening] in an engine's steady operation condition judged by said steady operation condition judging means - claim 6 whenever [said EGR valve-opening] including a steady operation condition judging means to judge an engine's steady operation condition.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is an internal combustion engine's EGR (exhaust air reflux). It is related with the technique which raised EGR control precision especially about a control unit.
[0002]
[Description of the Prior Art] In the internal combustion engine for cars, the EGR control unit which generally flows back in an inhalation-of-air system in a part of exhaust air for NOx reduction is adopted. As the conventional internal combustion engine's EGR control unit, there is a thing as shown, for example in JP,9-53519,A. The new air volume inhaled by engine rotational speed and the collector of an inhalation-of-air system in this thing, whenever [target fuel oil consumption and / current EGR valve-opening] -- command value (opening controlled variable) Desired value (the amount of target EGR(s)) of the amount of EGR(s) which is been alike and based, presumes the pressure in a collector, and the pressure in an EGR path, and passes the estimate and the EGR valve of both [these] pressures It is based, a command value is set up whenever [according to a new service condition / EGR valve-opening], and EGR control is performed.
[0003]
[Problem(s) to be Solved by the Invention] However, there are the following problems in such a conventional EGR control unit. That is, whenever [effectual EGR valve-opening / which whenever / said conventionally actual with equipment EGR valve-opening / is presuming the pressure in a collector and the pressure in an EGR path to the command value whenever / EGR valve-opening / on the assumption that abbreviation coincidence is carried out, but can pass EGR gas when the soot contained in the EGR gas which passes an EGR valve blocks an EGR valve] may decrease. In this case, the presumed precision of collector internal pressure and EGR path internal pressure will fall, consequently EGR control precision will fall.
[0004] In addition, this not only of the conventional method which performs said pressure presumption but a thing which sets up a command value whenever [direct EGR valve-opening] from loads, such as an engine's operational status, for example, engine rotational speed, and an accelerator opening, is the same, and unless a command value is set up whenever [EGR valve-opening] in consideration of plugging of an EGR valve, it is the same. This invention was made in view of such the conventional actual condition, and aims at offering the EGR control unit of the internal combustion engine which raised EGR control precision by presuming plugging of an EGR valve and amending EGR control.
[0005]
[Means for Solving the Problem] For this reason, invention concerning claim 1 sets a part of exhaust air through the EGR valve infixed in the EGR path which connects an engine's exhaust air system and inhalation-of-air system to the EGR control unit of the internal combustion engine which flows back in an inhalation-of-air system. While detecting the variation of the inhalation-of-air system internal pressure when carrying out specified quantity change of the opening of said EGR valve using parameters other than the opening of an EGR valve The differential pressure of the inhalation-of-air system internal pressure estimate before and behind said specified quantity change according to the opening of an EGR valve detects, both [these] the detection value is compared, the amount of plugging of an EGR valve is presumed, and it is characterized by amending the opening control value of the EGR valve according to this amount of plugging.
[0006] If specified quantity change of the opening of an EGR valve is carried out, as a result of the amount of EGR gas supplied in an inhalation-of-air system changing according to invention concerning claim 1, the

pressure in an inhalation-of-air system changes. Accuracy is asked for the detection value which detected the variation of this inhalation-of-air system internal pressure using parameters other than whenever [EGR valve-opening], without including the error by plugging of an EGR valve.

[0007] The detection value of the variation of inhalation-of-air system internal pressure which the detection value which, on the other hand, detected the variation of inhalation-of-air system internal pressure by the differential pressure of the inhalation-of-air system internal pressure before and behind said specified quantity change presumed from whenever [EGR valve-opening] will produce an error by reduction of whenever [EGR valve-opening], and will be asked for it by the differential pressure of the pressure estimate before and behind these change if plugging has each pressure estimate before and behind change in an EGR valve also produces an error.

[0008] Therefore, by comparing with a detection value including the error by plugging of an EGR valve the detection value which does not include the error by plugging of the EGR valve of the variation of these inhalation-of-air system internal pressure, the amount of plugging of this EGR valve can be presumed, and EGR control precision improves by amending the opening control value of the EGR valve according to this amount of plugging. Moreover, invention concerning claim 2 sets a part of exhaust air through the EGR valve infixed in the EGR path which connects an engine's exhaust air system and inhalation-of-air system to the EGR control unit of the internal combustion engine which flows back in an inhalation-of-air system, as shown in drawing 1 . Whenever [EGR valve-opening / which carries out specified quantity change of the opening of said EGR valve by the predetermined service condition] A compulsive change means, The 1st inhalation-of-air system internal pressure variation detection means which detects the variation of the inhalation-of-air system internal pressure when carrying out specified quantity change of whenever [EGR valve-opening] with a compulsive change means whenever [said EGR valve-opening] using parameters other than the opening of an EGR valve, An inhalation-of-air system internal pressure presumption means to presume the inhalation-of-air system internal pressure according to the opening of said EGR valve, The variation of the inhalation-of-air system internal pressure when carrying out specified quantity change of the opening of an EGR valve with a compulsive change means whenever [said EGR valve-opening] The 2nd inhalation-of-air system internal pressure variation detection means detected by the differential pressure of the inhalation-of-air system internal pressure before and behind said specified quantity change presumed with said inhalation-of-air system internal pressure presumption means, The 1st inhalation-of-air system internal pressure variation detected with said 1st inhalation-of-air system internal pressure variation detection means, The 2nd inhalation-of-air system internal pressure variation detected with said 2nd inhalation-of-air system internal pressure variation detection means is measured, the amount of plugging of an EGR valve is presumed, and it is characterized by constituting including a control value amendment means whenever [EGR valve-opening / which amends the opening control value of the EGR valve according to this amount of plugging].

[0009] If specified quantity change of whenever [EGR valve-opening] is compulsorily carried out with a compulsive change means whenever [EGR valve-opening], as a result of the amount of EGR gas supplied in an inhalation-of-air system changing according to invention concerning claim 2, the pressure in an inhalation-of-air system changes. The 1st inhalation-of-air system internal pressure detection means detects the variation of this inhalation-of-air system internal pressure using parameters other than whenever [EGR valve-opening]. Accuracy is asked for this detection value, without including the error by plugging of an EGR valve.

[0010] On the other hand, the 2nd inhalation-of-air system internal pressure detection means detects the variation of inhalation-of-air system internal pressure with an inhalation-of-air system internal pressure presumption means by the differential pressure of the estimate of the inhalation-of-air system internal pressure before and behind said specified quantity change according to the opening of an EGR valve. The detection value of the variation of inhalation-of-air system internal pressure which this detection value will produce an error by reduction of whenever [EGR valve-opening], and will be asked for it by the differential pressure of the pressure estimate before and behind these change if plugging has each pressure estimate before and behind change in an EGR valve also produces an error.

[0011] Whenever [EGR valve-opening], by comparing with a detection value including the error by plugging of an EGR valve the detection value which does not include the error by plugging of the EGR valve of the EGR valve of the variation of these inhalation-of-air system internal pressure, a control value amendment means presumes the amount of plugging of this EGR valve, and amends the opening control value of the EGR valve according to this amount of plugging. EGR control precision improves by presuming the amount of plugging of an EGR valve as mentioned above, and amending the opening control

value of an EGR valve.
[0012] Invention concerning claim 3 includes an inhalation new-air-volume detection means in an inhalation-of-air system to detect the new air volume inhaled in an inhalation-of-air system. Moreover, said 1st inhalation-of-air system internal pressure variation detection means It is characterized by computing the variation of the inhalation-of-air system internal pressure in this change order based on the detection value of the new air volume inhaled in the inhalation-of-air system by said inhalation new-air-volume detection means in an inhalation-of-air system before and after change of the specified quantity of whenever [said EGR valve-opening].
[0013] According to invention concerning claim 3, the Bernoulli's equation is used for the new air volume inhaled in an inhalation-of-air system, and it is a degree type (1). It can express like.
Qw={xrho2 (Pcol-Pa) a}1/2 xAtvo ... (1) It corrects. the new-air-volume (kg/s) Pcol:pressure Pa in an inhalation-of-air system (Pa) inhaled in Qw:inhalation-of-air system -- the new mind inlet-port opening area (m2) in a :(atmospheric pressure Pa) rhoa:atmospheric density (kg/m3) Atvo:inhalation-of-air system -- here Since it is thought that it does not change by the aforementioned formula about the new mind inlet-port opening area Atvo in atmospheric pressure Pa, atmospheric density rhoa, and an inhalation-of-air system when specified quantity change of whenever [EGR valve-opening] is carried out, The 1st inhalation-of-air system internal pressure variation detection means computes the variation of the inhalation-of-air system internal pressure in this change order based on the detection value of the new air volume inhaled in the inhalation-of-air system detected by the inhalation new-air-volume detection means in an inhalation-of-air system. There is no element of whenever [EGR valve-opening] in the aforementioned formula, therefore the calculation value of the variation of inhalation-of-air system internal pressure does not produce the error by plugging of an EGR valve.
[0014] Thus, the variation of inhalation-of-air system internal pressure can be computed, without forming a pressure sensor. Moreover, invention concerning claim 4 is characterized by said 1st inhalation-of-air system internal pressure variation detection means computing the variation of the inhalation-of-air system internal pressure in this change order based on the detection value of the inhalation-of-air system internal pressure by said inhalation-of-air system internal pressure detection means in the change order of the specified quantity of whenever [said EGR valve-opening] including an inhalation-of-air system internal pressure detection means to detect the pressure in an inhalation-of-air system.
[0015] According to invention concerning claim 4, the 1st inhalation-of-air system internal pressure variation detection means computes the variation of the inhalation-of-air system internal pressure in this change order based on the detection value of the inhalation-of-air system internal pressure by which direct detection was carried out with said inhalation-of-air system internal pressure detection means in the change order of the specified quantity of whenever [said EGR valve-opening]. Thereby, the amount of operations for detecting the variation of this inhalation-of-air system internal pressure can be decreased.
[0016] Moreover, it is characterized by said inhalation-of-air system internal pressure presumption means presuming inhalation-of-air system internal pressure based on engine rotational speed, the new air volume inhaled in an inhalation-of-air system, the fuel quantity supplied to an engine, and whenever [EGR valve-opening] in invention concerning claim 5. According to invention concerning claim 5, said inhalation-of-air system internal pressure presumption means The time constant of the dynamic characteristics produced with the inhalation-of-air system volume is computed with engine rotational speed. The new air volume inhaled by the cylinder based on this time constant and the new air volume inhaled in an inhalation-of-air system is computed. The temperature in an EGR path is computed based on the fuel quantity supplied to an engine, the amount of EGR(s) inhaled by the cylinder [else / whenever / EGR valve-opening] is computed, and the pressure in an inhalation-of-air system is presumed based on these calculation value.
[0017] Moreover, an EGR path internal pressure presumption means by which invention concerning claim 6 presumes the pressure in the EGR path according to the opening of an EGR valve, Setting up a controlled variable based on the estimate of the EGR path internal pressure by an implication and this EGR path internal pressure presumption means, the estimate of the inhalation-of-air system internal pressure by said inhalation-of-air system internal pressure presumption means, or the detection value of inhalation-of-air system internal pressure whenever [according to the amount of target EGR(s) / EGR valve-opening], and performing EGR control By amending the estimate of whenever [EGR valve-opening / which presumes the amount of plugging of whenever / said EGR valve-opening /, and is used for presumption of EGR path internal pressure at least], it is characterized by amending a controlled variable whenever [EGR valve-opening].
[0018] According to invention concerning claim 6, an EGR path internal pressure presumption means

presumes the pressure in the EGR path according to whenever [EGR valve-opening], sets up a controlled variable whenever [EGR valve-opening] according to the amount of target EGR(s) based on the estimate of this EGR path internal pressure, the estimate of the inhalation-of-air system internal pressure by the inhalation-of-air system internal pressure presumption means, or the detection value of inhalation-of-air system internal pressure, and performs EGR control.

[0019] And by amending whenever [EGR valve-opening / which presumes the amount of plugging of said EGR valve, and is used for presumption of EGR path internal pressure at least] By being able to amend to the value which does not include the error according the estimate of this EGR path internal pressure to plugging of an EGR valve, and setting up the opening control value of this EGR valve using the estimate of the this amended pressure Without producing the error according the opening of a actual EGR valve to plugging of an EGR valve, it can amend so that it may become the opening from which the amount of target EGR(s) is obtained.

[0020] In addition, when using the estimate of the inhalation-of-air system internal pressure according to whenever [by said inhalation-of-air system internal pressure presumption means / EGR valve-opening] as inhalation-of-air system internal pressure used for setting out of a control value whenever [EGR valve-opening], the estimate of this inhalation-of-air system internal pressure can also be amended to the value which does not include the error by plugging of an EGR valve. Moreover, a compulsive change means is characterized by carrying out specified quantity change of whenever [EGR valve-opening] in an engine's steady operation condition judged by said steady operation condition judging means whenever [said EGR valve-opening] including a steady operation condition judging means by which invention concerning claim 7 judges an engine's steady operation condition.

[0021] According to invention concerning claim 7, by carrying out specified quantity change of whenever [EGR valve-opening] in an engine's steady operation condition judged by the steady operation condition judging means, and amending a controlled variable whenever [based on presumption and this estimate of the amount of plugging of an EGR valve / EGR valve-opening], the presumed precision of the amount of plugging of whenever [EGR valve-opening] improves, as a result EGR control precision improves.

[0022]

[Embodiment of the Invention] The operation gestalt of this invention is explained based on drawing below. In drawing 2 which shows the configuration of the hardware of 1 operation gestalt, a supercharger 1 carries out the compression supercharge of the air which was removed by the air filter 2 in dust and inhaled at the inhalation-of-air path 3 by inhalation-of-air compressor 1A, and sends it into the inlet manifold 4 of the downstream.

[0023] On the other hand, it distributes to each cylinder from a jet pump 7, and feeding supply of the fuel is carried out, from this fuel injection nozzle 6, a fuel is injected towards a combustion chamber by the fuel injection nozzle 6 with which an engine's 5 combustion chamber was equipped, and the this injected fuel lights and burns in it in the compression stroke last stage. Moreover, while the EGR path 10 which connected the exhaust manifold 8 and the inlet manifold 4, and infixed the EGR valve 9 is connected The throttle valve 31 for making it easy to EGR by extracting inhalation of air to the upstream of inhalation-of-air compressor 1A of said inhalation-of-air path 3 at the time of EGR control, and expanding the differential pressure of an exhaust pressure and an intake pressure is infixed. The opening of the EGR valve 9 is controlled and EGR control is performed at the same time it mainly extracts said throttle valve 31 for an exhaust air improvement and the cure against the noise at the time of an idle and a low load. The EGR rate is controlled by controlling and having the pressure led to the pressure room of said EGR valve 9, and controlling an opening by controlling a dilution rate with atmospheric air by the solenoid valve 12 by which duty control is carried out in said negative pressure at the same time it leads the negative pressure from a vacuum pump 11 to diaphragm equipment 33 through a solenoid valve 32 and specifically extracts said throttle valve 31. These EGR rates and fuel-injection control are performed by the control unit 13.

[0024] party curate contained during exhaust air after the exhaust air after combustion carries out revolution actuation of the exhaust gas turbine 1B of said supercharger 1 from an exhaust manifold 8 (exhaust air particle) etc. -- uptake is carried out with a filter 14, and after being muffled by the muffler 15, it is emitted into atmospheric air. The coolant temperature sensor 19 grade which detects the rotational-speed sensor 17 which the air flow meter 16 which detects an intake air flow is formed in the inhalation-of-air path 3 of the inhalation-of-air compressor 1A upstream of said supercharger 1, and detects the engine rotational speed Ne, the lever opening sensor 18 which detects the control-lever opening of said fuel injection pump 7, and water temperature is prepared, the opening control value of the EGR valve 9 is set up based on these detection values, the EGR valve 9 is driven and EGR control is performed so that it may become this opening.

[0025] Drawing 3 shows control-block drawing of the EGR control in the gestalt of this operation. Explanation of the function of each block detects the engine rotational speed N in the engine rotational-speed detecting element 51 based on the signal from said rotational-speed sensor 17. The collector inhalation new-air-volume detecting element 52 detects the new air volume inhaled by the collector of the inhalation-of-air path 3 based on the signal from said air flow meter 16 as an inhalation new-air-volume detection means in an inhalation-of-air system.
[0026] In the target fuel-oil-consumption setting-out section 53, target fuel oil consumption is set up based on engine operational status. The basic fuel oil consumption Mqdrv is specifically calculated by retrieval from a map table etc. from said detected engine rotational speed N and the control-lever opening CL detected by said lever opening sensor 18, various correction factors, such as water temperature, amend this, and target fuel oil consumption is set up.
[0027] Collector internal pressure and the EGR path internal pressure presumption section 54 are constituted [whenever / dynamic characteristics presumption section 54a, cylinder inhalation new-air-volume calculation section 54b, amount calculation section of cylinder inhalation EGR(s) 54c, 54d / of collector internal pressure calculation sections /, amount calculation section of collector inhalation EGR(s) 54e, and EGR path internal temperature] by 54g of calculation sections, and 54h of EGR path internal pressure calculation sections whenever [54f / of calculation sections /, and collector internal temperature], as shown in drawing 4 . In addition, the function of this collector internal pressure and EGR path internal pressure presumption section 54 constitutes an inhalation-of-air system internal pressure presumption means and an EGR path internal pressure presumption means.
[0028] The engine rotational speed detected by the engine rotational-speed detecting element 51 is used for dynamic characteristics presumption section 54a, and it is a degree type (2). The shown operation is performed and time constant taua of the dynamic characteristics produced with a collector is computed. taua= (30xVcol)/(NxVcylxetav) ... (2) However, time constant (s) of the dynamic characteristics produced with a taua:collector N: -- engine rotational-speed (rpm) Vcol:collector volume (m3) Vcyl:cylinder-capacity (m3) etav: -- volumetric efficiency -- here, Vcol and Vcyl are given as a constant. Sensing of the etav may be carried out and it may give a standard value.
[0029] The new air volume inhaled in cylinder inhalation new-air-volume calculation section 54b by the collector detected by said collector inhalation new-air-volume detecting element 52 and time constant taua of said dynamic characteristics presumed by dynamic characteristics presumption section 54a are used, and it is a degree type (3). An operation [like] is performed and the new air volume inhaled by the cylinder is calculated. (3) A formula expresses the relation of first-order lag using the formula of a discrete-time system.
[0030]
Qcw=exp (- deltat/taua) x (Z-1Qcw) + [However, new-air-volume (kg/s) deltat inhaled by the new-air-volume (kg/s) Qw:collector inhaled by the Qcw:cylinder: Sampling period (s) Here, deltat is given as a constant.] {1-exp (- deltat/taua)} x (Z-1Qcw) ... (3)
[0031] The amount of EGR(s) inhaled by the collector computed by amount calculation section of collector inhalation EGR(s) 54e in amount calculation section of cylinder inhalation EGR(s) 54c as mentions later, and time constant taua of the dynamic characteristics presumed by said dynamic characteristics presumption section 54a are used, and it is a degree type (4). An operation [like] is performed and the amount of EGR(s) inhaled by the cylinder is calculated. () A formula expresses the relation of first-order lag using the formula of a discrete-time system.
[0032]
Qce=exp (- deltat/taua) x (Z-1Qce) + [However, amount / of EGR(s) / (kg/s) deltat inhaled by the amount (kg/s) Qe:collector of EGRs inhaled by the Qce:cylinder: Sampling period (s) Here, deltat is given as a constant.] {1-exp (- deltat/taua)} x (Z-1Qce) ... (4)
[0033] The temperature in said collector computed as mentions later by 54g of calculation sections the detected engine rotational speed N and whenever [collector internal temperature], said computed cylinder inhalation new air volume, and the amount of cylinder inhalation EGR(s) are used for 54d of collector internal pressure calculation sections, and they are a degree type (5). An operation [like] is performed and it asks for the pressure Pcol in a collector.
Pcol=Pox (Qcw+Qce) x (30-/N) x (Tcol/To) x {1/(eta vxrho colxVcyl)} ... (5) It corrects. (pressure Pa) rhocol: in a Pcol:collector -- (temperature K) To: in the consistency (kg/m3) Tcol:collector in the collector in reference condition -- (absolute-temperature K) Po: which shows reference condition -- the absolute pressure (Pa) which shows reference condition -- here, Vcyl, and Po and To are given as a constant. Sensing

of the rhocol may be carried out and it may give a standard value.
[0034] In amount calculation section of collector inhalation EGR(s) 54e, the amount of EGR(s) inhaled by the collector is computed from the pressure in the EGR path 10 computed so that it may mention later in the opening of the EGR valve 9 presumed by the presumed section 59 whenever [EGR valve-opening / which is mentioned later], the pressure Pcol in said computed collector, and 54h of EGR path pressure calculation sections. First, it asks for the opening area of the EGR valve 9 from the opening of the presumed EGR valve 9. What is necessary is to prepare beforehand the opening of the EGR valve 9, and the relation of the opening area of the EGR valve 9 as a map, and just to specifically ask for them by retrieval from this map etc. This example of an EGR valve opening area map is shown in drawing 7 .
[0035] Next, degree type (6) An operation [like] is performed and the amount of EGR(s) inhaled by the collector is computed.
Qe={xrho2 (Pexh-Pcol) exh}1/2 xSegr ... (6) However, (pressure Pa) rhoexh in the (pressure Pa) Pcol:collector in the amount (kg/s) Pexh[of EGR(s)]:exhaust pipe inhaled by Qe:collector: Sensing of the exhaust air consistency (kg/m3) Segr:EGR valve opening area (m2) rhoexh in reference condition may be carried out, and it may give a standard value.
[0036] 54f of calculation sections searches for the temperature in the EGR path 10 based on the target fuel oil consumption set up by said target fuel-oil-consumption setting-out section 53 whenever [EGR path internal temperature]. What is necessary is to prepare beforehand the relation of whenever [target fuel-oil-consumption and EGR path internal temperature] as a map, and just to specifically ask by retrieval from this map etc. The example of a presumed map is shown in drawing 8 whenever [this EGR path internal temperature].
[0037] 54g of calculation sections searches for the temperature in a collector based on the temperature in the EGR path 10 computed by 54f of calculation sections whenever [said EGR path internal temperature], the cylinder inhalation air content computed by said cylinder inhalation air content calculation section 54b, and the amount of cylinder inhalation EGR(s) computed by said amount calculation section of cylinder inhalation EGR(s) 54c whenever [collector internal temperature].
[0038] To the beginning, it is a degree type (7). An operation as shown is performed and an EGR rate is searched for.
Regr= (Qce/Qcw) x100 ... the temperature in a collector is searched for based on (7) however the amount (kg/s) of EGR(s) inhaled by the new-air-volume (kg/s) Qce:cylinder inhaled by the Regr:EGR rate (%) Qcw:cylinder next the EGR rate which is the above, and was made and searched for, and whenever [EGR path internal temperature]. What is necessary is to prepare beforehand the relation between an EGR rate, whenever [EGR path internal temperature], and, whenever [collector internal temperature] as a map, and just to specifically ask by retrieval from this map etc. The example of a presumed map is shown in drawing 9 whenever [this collector internal temperature].
[0039] 54h of EGR path internal pressure calculation sections asks for the pressure in the EGR path 10 based on 54f of calculation sections, and the engine rotational speed N detected by engine rotational-speed detecting-element 54a whenever [amount / which is inhaled by the collector computed by said amount calculation section of collector inhalation EGR(s) 54e / of EGR(s), cylinder inhalation new-air-volume / which was computed by said cylinder inhalation new-air-volume calculation section 54b /, and said EGR path internal temperature].
[0040] To the beginning, it is a degree type (8). An operation [like] is performed.
Kegr= (Qcw-Qec) xTegrx (N/30) ... (8) However, Qcw: New air volume inhaled by the cylinder (kg/s)
Qe: The amount of EGR(s) inhaled by the collector (kg/s)
Temperature in a Tegr:EGR path (K)
Ne : engine rotational speed (rpm)
Kegr is an in-between variable.
[0041] Next, it asks for the pressure in the EGR path 10 from Kegr. What is necessary is to prepare beforehand the relation between Kegr and the pressure in an EGR path as a map, and just to ask for it by retrieval from this map etc. The example of this EGR path internal pressure presumption map is shown in drawing 10 . The amount of EGR(s) which wants to pass the EGR valve 9 so that it may return to drawing 3 and may become a suitable EGR rate to compensate for change of operational status in the demand EGR valve passage flow rate setting-out section 55 (the amount of target EGR(s)) It sets up.
[0042] The command value setting-out section 56 sets up the opening command value of the EGR valve 9 based on the amount of target EGR(s) set up with the demand EGR valve passage flow rate setting-out means, the pressure in the collector computed in 54d of said collector internal pressure calculation sections,

and the pressure in the EGR path 10 computed in 54h of EGR path internal pressure calculation sections whenever [EGR valve-opening]. To the beginning, it is a degree type (9). An operation [like] is performed and the desired value of an EGR valve opening area is calculated.
[0043]
YSegr=Qex [{xrho2 (Pexh-Pcoh) exh}1 / 2] -1 ... (9)
However, Qe: The amount of EGR(s) inhaled by the collector (kg/s)
Pexh: The pressure in a flueway (Pa)
Pcol: The pressure in a collector (Pa)
rhoexh: The exhaust air consistency in reference condition (kg/m3)
Sensing of the YSegr:EGR valve opening area desired value (m2) rhoexh may be carried out, and it may give a standard value.
[0044] Next, a command value is calculated whenever [EGR valve-opening] from YSegr. What is necessary is to prepare relation with a command value as a map beforehand whenever [YSegr and EGR valve-opening], and just to specifically ask by retrieval from this map etc. The example of a command value setting-out map is shown in drawing 11 whenever [this EGR valve-opening]. The EGR valve control unit 57 operates an EGR valve so that whenever [actual EGR valve-opening] may approach a command value whenever [EGR valve-opening / of ** the 2nd calculated so that it may mention later by the command value modification section 58 whenever / EGR valve-opening].
[0045] The EGR valve 9 opens and closes the EGR path 10 according to the output of the EGR valve control unit 57. Whenever [EGR valve-opening], the presumed section 59 is based on a command value whenever [correction factor / which was set up in the correction factor setting-out section 63 mentioned later /, and EGR valve-opening / of ** the 2nd changed in the command value modification section 58 whenever / said EGR valve-opening], and is a degree type (10). An operation [like] is performed and it asks for whenever [EGR valve-opening].
[0046]
Aegr=MAegr2xKegr ... (10)
However, whenever [Aegr:EGR valve-opening] (%)
MAegr: It is a command value (%) whenever [EGR valve-opening / of ** a 2nd].
Kegr: The correction factor diagnostic activation section 60 is constituted by operational status judging section 60a and diagnostic activation decision section 60b as shown in drawing 5 . Each element is explained below.
[0047] Operational status judging section 60a performs the following things based on the target fuel oil consumption set up in the target fuel-oil-consumption setting-out section 53, and the engine rotational speed N detected by the engine rotational-speed detecting element 51. A map like drawing 10 classified into two or more fields by making target fuel oil consumption and engine rotational speed into a parameter is set up, and when the point which makes the input of the two above-mentioned parameters a coordinate is settled in the specific field beyond the predetermined period, the signal showing a steady state is outputted.
[0048] Diagnostic activation decision section 60b makes a judgment which performs a diagnosis of plugging of the EGR valve 9, while the operational status judging section is outputting the signal showing a steady state at least. In addition, the conditions of making it not diagnose etc., if a fixed period does not pass since the last diagnosis on the assumption that plugging of the EGR valve 9 does not advance in a short period may be added.
[0049] The command value modification section 58 calculates [whenever / EGR valve-opening / whenever / diagnostic activation decision result / by diagnostic activation decision section 60b /, and EGR valve-opening / which was set up by the command value setting-out section 56 whenever / EGR valve-opening] a command value whenever [EGR valve-opening / of ** a 2nd] based on a command value. Whenever [this EGR valve-opening / of ** a 2nd], although a command value carries out specified quantity reduction of the command value whenever [EGR valve-opening] after t 1-second progress after diagnostic activation decision section 60b judges activation of a diagnosis, as shown in drawing 13 It is again made in agreement [after t 2 second progress / whenever / EGR valve-opening] with a command value furthermore (although the increment in ****** may be carried out, the case where it is made to decrease is assumed with the gestalt of this operation.). .
[0050] Moreover, when omitting said diagnosis, a command value is made in agreement [whenever / EGR valve-opening / of ** a 2nd / whenever / EGR valve-opening / which was set up by the command value setting-out section whenever / EGR valve-opening] with a command value. The 1st collector internal pressure variation calculation section 61 is constituted by order [specified quantity change] collector

inhalation new-air-volume calculation section 61a and 1st collector internal pressure variation calculation section 61b as shown in drawing 6 . this -- the 1st collector internal pressure variation calculation section 61 constitutes the 1st inhalation-of-air system internal pressure variation detection means. Each element is explained below.

[0051] Order [specified quantity change] collector inhalation new-air-volume calculation section 61a The new air volume inhaled by the collector of the back before carrying out specified quantity reduction of the command value whenever [EGR valve-opening / of ** a 2nd] based on the decision result of the diagnostic activation by diagnostic activation decision section 60b and the new air volume inhaled by the collector detected by the collector inhalation new-air-volume detecting element 52 is calculated (hereafter). new air volume which sets to Qw1 new air volume inhaled by the collector before carrying out specified quantity reduction, and is inhaled by the collector after carrying out ****** reduction is set to Qw2. .

[0052] the new air volume inhaled by the collector as shown in { drawing 14 which is the new air volume inhaled by the collector in the event of Qwl and Qw2 specifically having a steady flow rate as shown in drawing 14 carries out specified quantity reduction of the command value whenever [EGR valve-opening / of ** a 2nd] -- increasing (Qw2> it being set to Qw1) -- it is **. }. 1st collector internal pressure variation calculation section 61b New air volume inhaled by the collector before carrying out ****** reduction of the command value whenever [EGR valve-opening / of ** a 2nd / which was computed by order / specified quantity change / collector inhalation new-air-volume calculation section 61a] (Qw1) New air volume inhaled by the collector after carrying out specified quantity reduction (Qw2) It is based. The variation (it considers as the 1st collector internal pressure variation) of the pressure in a collector is calculated.

[0053] First, the map in which the relation of the differential pressure of the new air volume beforehand inhaled by the collector as shown in drawing 15 by experiment etc., the upstream (equivalent to an atmospheric-air side) of the new mind entry of a collector, and the downstream (equivalent to a collector side) is shown is prepared. The map of drawing 13 can also be asked by (1) type. It asks for the 1st differential pressure SPtvo1 later mentioned from Qw1 using the map of drawing 13 R> 3, and asks for the 2nd differential pressure SPtvo2 later mentioned from Qw2. The 1st collector internal pressure variation asks by performing an operation like a degree type (11).

[0054]

deltaPcol1=SPtvo2-SPtvo1 ... (11) However, SPtvo1: Differential pressure in the collector new mind entry before carrying out specified quantity reduction of the command value whenever [EGR valve-opening / of ** a 2nd] (Pa)

SPtvo2: Differential pressure in the collector new mind entry after carrying out ****** reduction of the command value whenever [EGR valve-opening / of ** a 2nd] (Pa)

deltaPcol1: 1st collector internal pressure variation (Pa)

The 2nd collector internal pressure variation calculation section 62 calculates the 2nd collector internal pressure variation based on the decision result of the diagnostic activation by said diagnostic activation decision section 60, and the pressure in the collector computed by the collector internal pressure calculation section. As the 2nd collector internal pressure variation is shown in drawing 16 , specifically, it is the variation of the collector internal pressure estimate presumed by collector internal pressure and the EGR path internal pressure presumption section 54 before and after a diagnosis is ****(ed) and a command value carries out specified quantity reduction whenever [EGR valve-opening / of ** a 2nd]. this -- the 2nd collector internal pressure variation calculation section 62 constitutes the 2nd inhalation-of-air system internal pressure variation detection means.

[0055] The correction factor setting-out section 63 sets up a correction factor based on the decision result of the diagnostic activation by diagnostic activation decision section 60b, the 1st collector internal pressure variation computed by the 1st collector internal pressure variation calculation section 61, and the 2nd collector internal pressure variation computed by the 2nd collector internal pressure variation calculation section 62. This correction factor setting-out section 63 constitutes a control value amendment means whenever [EGR valve-opening].

[0056] First, an operation like a degree type (12) type is performed.

RPcol=(delta Pcol2/delta Pcol1) x100 ... (12)

However, deltaPcol1: 1st collector internal pressure variation (Pa)

**Pcol2: 2nd collector internal pressure variation (Pa)

RPcol is an in-between variable.

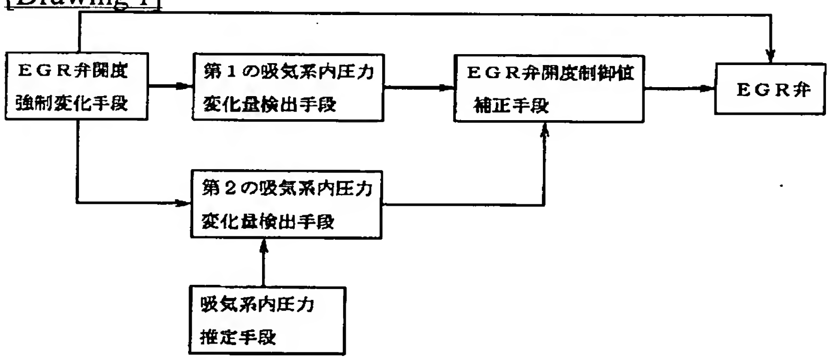
[0057] Next, it asks for a correction factor from RPcol. What is necessary is to specifically prepare the relation between RPcol and a correction factor as a map beforehand, and just to ask by retrieval from this

map etc. The example of a correction factor setting-out map is shown in drawing 17 . In addition, when the output of a decision result that diagnostic activation by the diagnostic activation decision section 60 is performed does not continue beyond a predetermined period, it judges that operational status shifted to the transient during a plugging diagnosis of the EGR valve 9, and let the correction factor then called for be an invalid. When the output of a decision result that said diagnostic activation is performed continues beyond a predetermined period, it supposes that it is effective and a correction factor is changed.
[0058] Drawing 18 is a flow chart which shows the routine of a diagnosis of plugging of said EGR valve 9, and setting out of a correction factor. Next, the gestalt of the 2nd operation is explained. It has the collector internal pressure detecting element 71 which detects the pressure in a collector with the gestalt of the 2nd operation based on the signal of the pressure sensor as an inhalation-of-air system internal pressure detection means by which calculation of the 1st collector internal pressure variation was prepared in the collector as shown in drawing 19 . Variation of collector internal pressure before and after carrying out specified quantity change of whenever [EGR valve-opening / by which 1st collector internal pressure variation calculation section 61' was detected by said collector internal pressure detecting element 71] (refer to drawing 20) The points computed directly differ and other configurations are the same as that of the gestalt of the 1st operation.
[0059] With the gestalt of the 2nd operation, the amount of operations can be lessened by having a collector internal pressure detecting element as compared with the gestalt of the 1st operation.

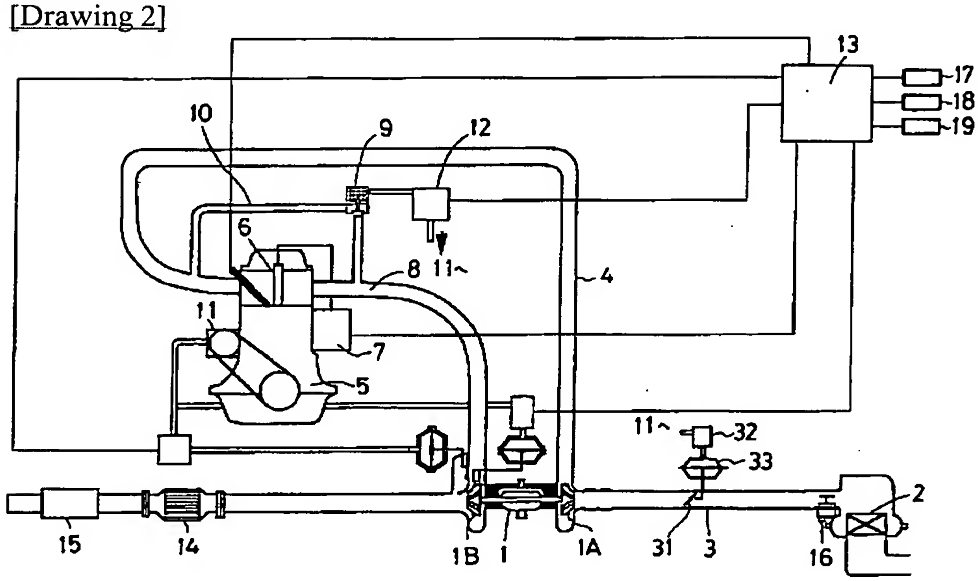
[Translation done.]

DRAWINGS

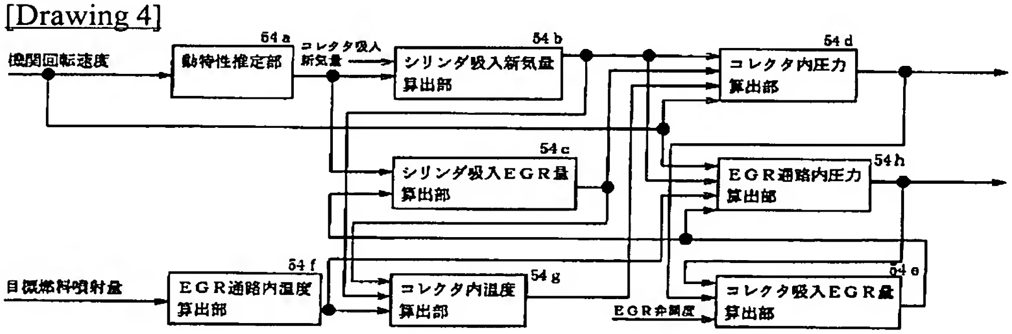
[Drawing 1]



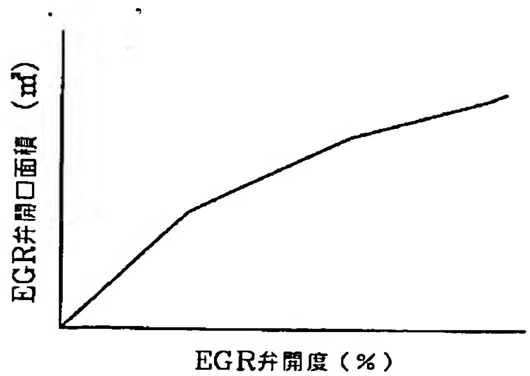
[Drawing 2]



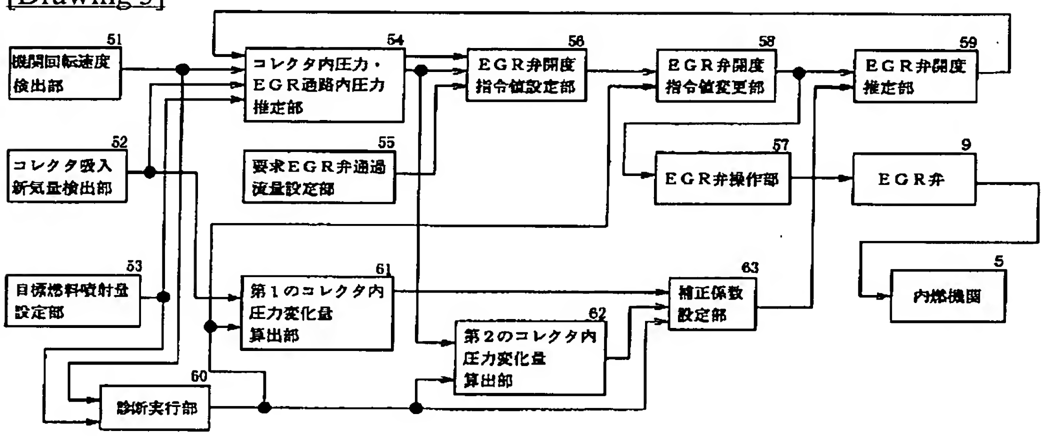
[Drawing 4]



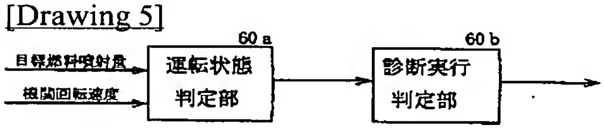
[Drawing 7]



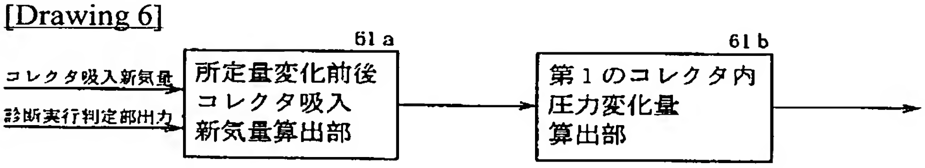
[Drawing 3]



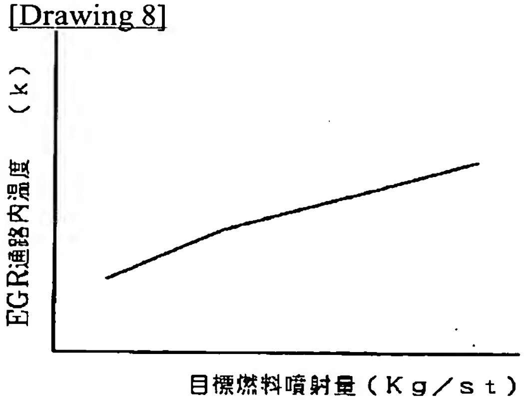
[Drawing 5]



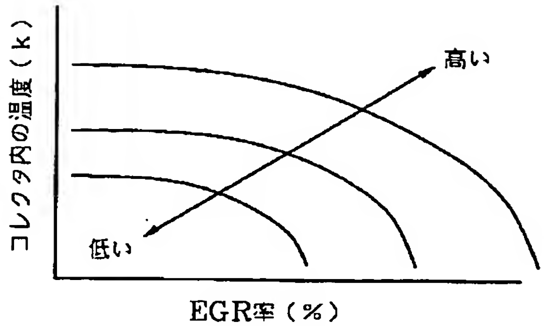
[Drawing 6]



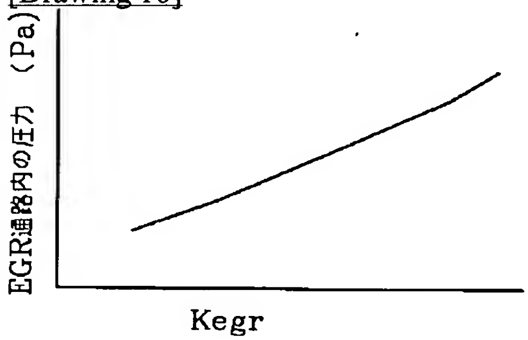
[Drawing 8]



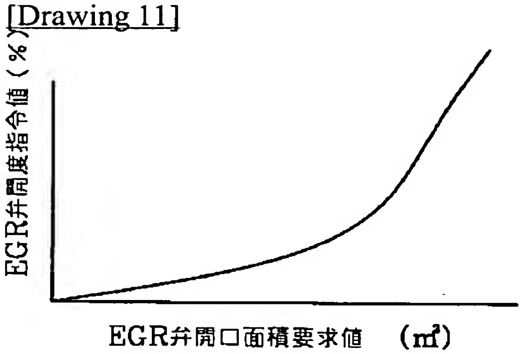
[Drawing 9]



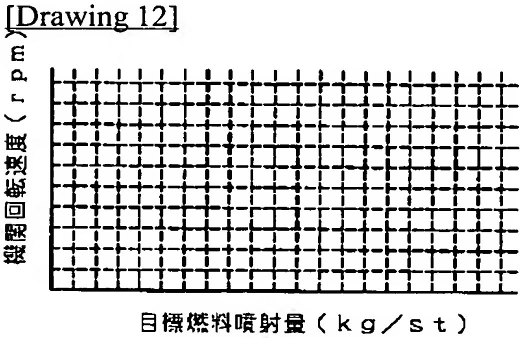
[Drawing 10]



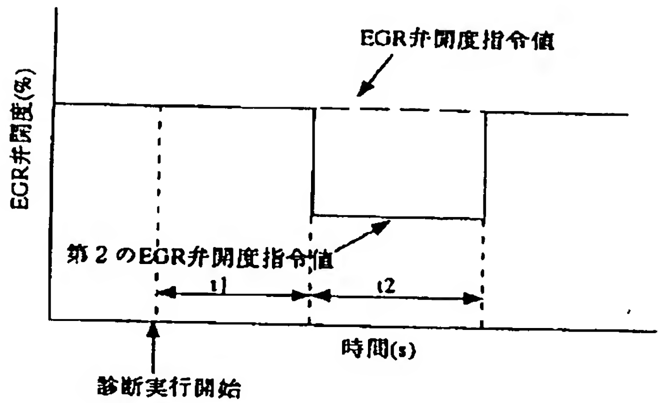
[Drawing 11]



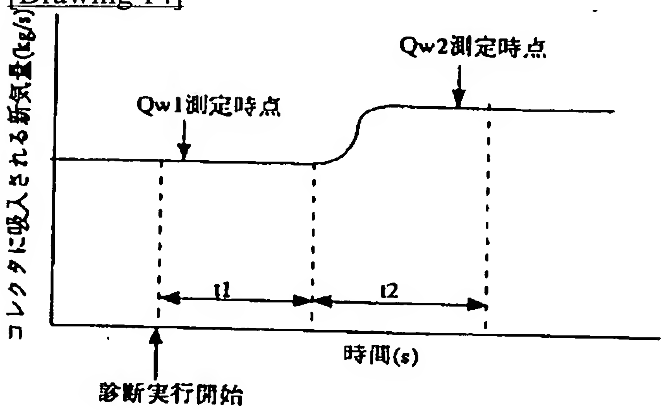
[Drawing 12]



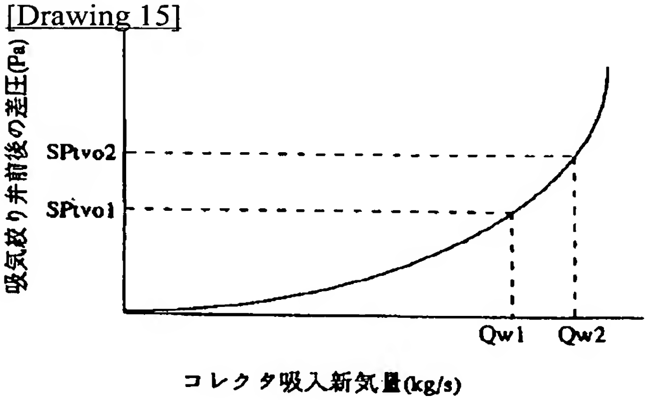
[Drawing 13]



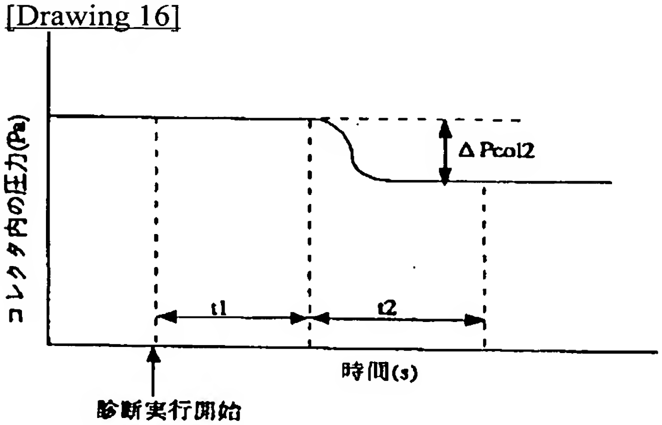
[Drawing 14]



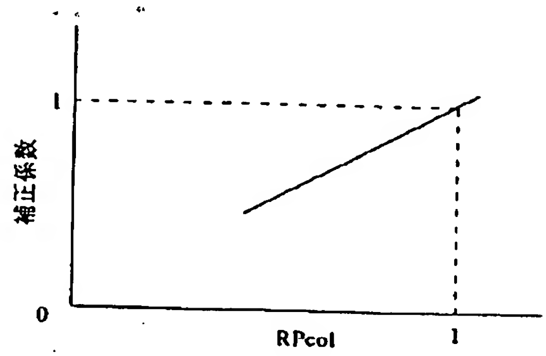
[Drawing 15]



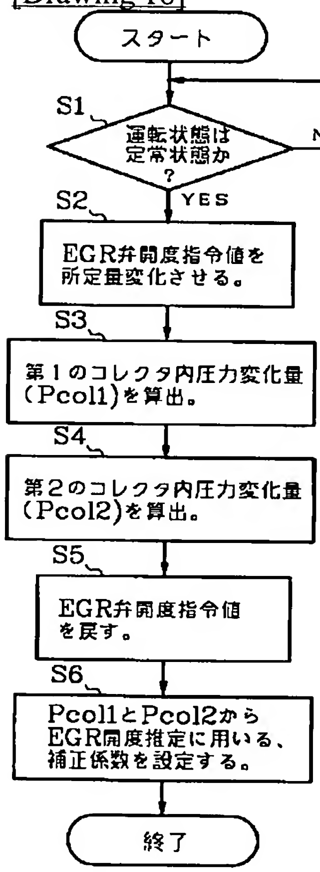
[Drawing 16]



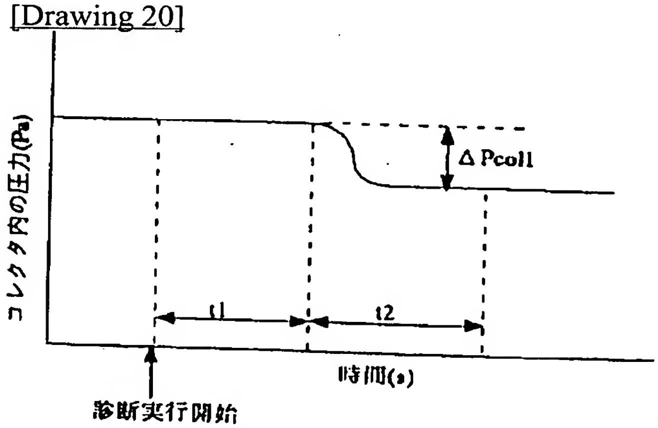
[Drawing 17]



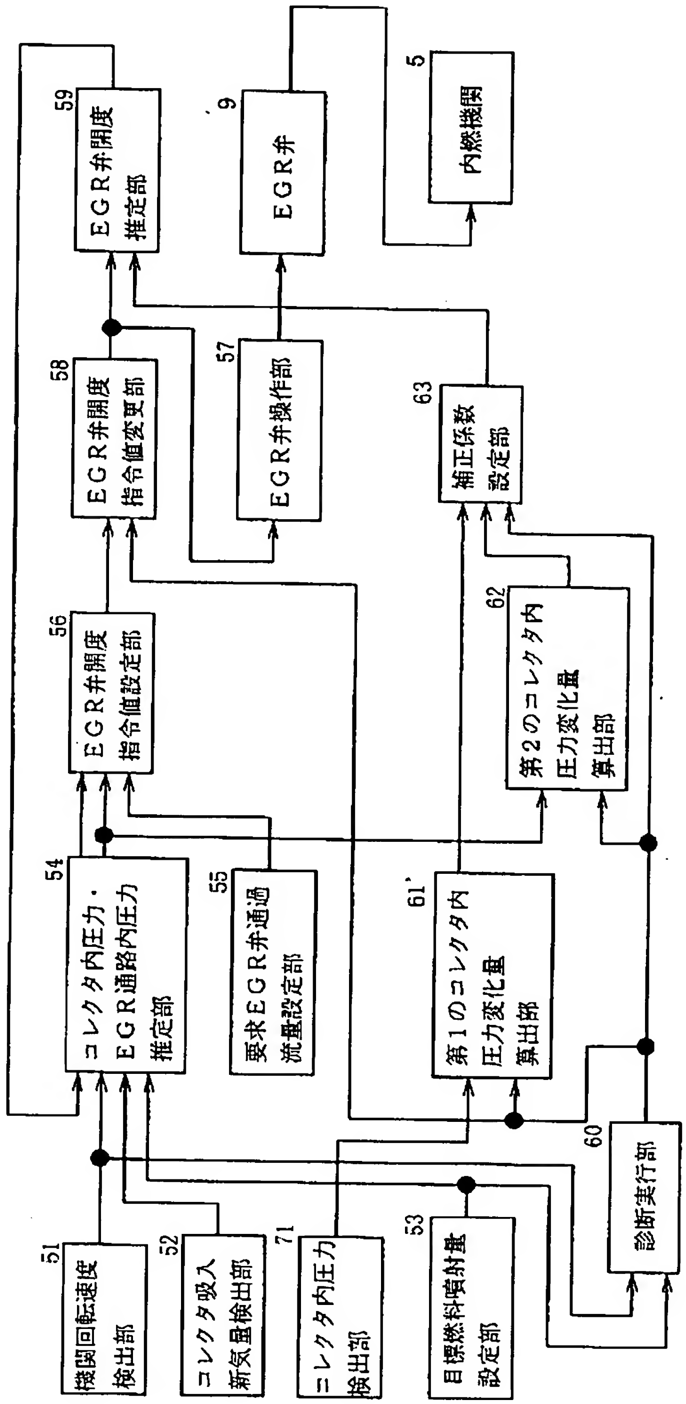
[Drawing 18]



[Drawing 20]



[Drawing 19]



[Translation done.]